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PHYSICO-CHEMICAL CONSTANTS
OF
PURE ORGANIC COMPOUNDS

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INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

PHYSICO-CHEMICAL CONSTANTS OF PURE ORGANIC COMPOUNDS

by

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PREFACE

The present work is among the fruits of a quarter of a century's activity of the International Bureau of Physico-chemical Standards, and combines the results obtained in their laboratories with those provided by a systematic harvesting of the whole of the chemical literature up to January 1st, 1950. I desire to state that this work could not have been realised without the generous support of the Belgian Chemical Industry and of the Belgian National Fund for Scientific Research.

I take this opportunity of expressing my thanks to those of my collaborators whose publications are quoted in the bibliographical table, and in particular to Mme *Hennaut-Roland*, assistant at the Bureau during a number of years, who has taken a very active part in the experimental work and also in the preparation of the manuscript and the correction of the proofs. I would also like to thank Mr. *Geoffrey Middleton*, B. Sc., F.R.I.C., who undertook the translation of the French text into English and to whom we owe a number of suggestions used in the presentation of this work.

It is inevitable that in such a work there should be errors and omissions; I should be particularly grateful to any of my colleagues if they would inform me of any that they observe.

Brussels, January, 1950

JEAN TIMMERMANS
Professor of Physical Chemistry at the Université Libre de Bruxelles
Director of the International Bureau of Physico-chemical Standards

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INTRODUCTION

1. OBJECT OF THE WORK

This work records, as completely as possible, those physico-chemical constants of organic compounds which have been measured with sufficient care to warrant their acceptance as data established with a precision worthy of contemporary science.

Such a definition excludes at once the great majority of the numerical data which have accumulated during a century. Among some tens of thousands of compounds, the majority have been examined from a chemical point of view only (method of preparation and reactivity) and the samples used can not be considered as very pure. Only a few thousands of compounds of particular interest have been the subject of numerous and careful determinations; an enormous number must be rejected because so few measurements are satisfactory, both with regard to the purity of the sample and the accuracy of the method of physical measurement which has been used. The difficulties to be overcome will be better understood after a study of the book written by J. TIMMERMANS: "*La Notion d'Espèce en Chimie*" (Paris, Gauthier-Villars, 1928), which, according to HILL [1], contains the most complete and systematic codification of the precautions which must be taken in order that a constant may acquire the character of a real physico-chemical standard [2].

We will sum up these factors by stating that the sample examined must be of a sufficient purity, and the method of measurement of such a degree of sensitiveness and precision that, thanks to a harmonious equilibrium between the different sources of error, one may be sure of the penultimate decimal given; the uncertainty resting only with the last figure.

Accordingly, we intend to include in the present publication only those values of physico-chemical constants of organic compounds which have positive guarantees of precision; we have therefore rejected, not only the results of obviously inaccurate work, but also the innumerable publications which do not give any details to allow of an appreciation of the precision; among those results some are possibly accurate and may even be of considerable interest from other points of view, but they can not be considered as established with a sufficient degree of certainty to be accepted as true standards. For the same reason, it is in exceptional cases only that we have studied the compounds for which only one author has determined the usual constants of organic chemistry (boiling and melting point, density and refractive index at one temperature only), and the compounds for which the heat of combustion forms the sole object of the research.

---

[1] *J. Am. Chem. Soc.*, 50 (1928) 2847.

[2] This work has been brought up to date and translated by Prof. RALPH E. OESPER under the title of "*Chemical Species*". New York and London, 1940—1941.

2. PHYSICAL PROPERTIES AND CRITERIA OF PURITY

We enumerate briefly below the chief criteria of purity currently used in organic chemistry, the systematic application of which has forced us to reject the great majority of published results. The constants normally determined with sufficient accuracy may be classified under three headings.

A. CONSTANTS OF HETEROGENEOUS EQUILIBRIA

a) At a given pressure, a pure substance has a constant *boiling point*, invariable from the beginning to the end of the distillation. We have rejected all samples for which the boiling range exceeds one tenth of a degree; for commercial substances, where large quantities of material are available, we have moreover only considered samples distilling within the limits of some hundredths of a degree. The use of SWIETOSLAWSKI's ebulliometer will make it possible in the future to check the constancy of the boiling point of a sample to nearly one thousandth of a degree. (See the investigations of the collaborators of SWIETOSLAWSKI [1] and of GILLO [2]).

The *boiling point* should be known to about 0.05°, with regard to its absolute value; the work of recent years has brought new complications in the choice of the scale of reference (on this question, see p. 14).

b) The *saturated vapour pressure* of a pure substance remains strictly constant during the whole range of isothermal liquefaction (S. YOUNG) [3]. We have rejected samples for which the pressure changed by more than one five-hundredth of its value from the beginning to the end of the isothermal liquefaction or vaporization. The pressure of the saturated vapour is very sensitive to the presence of dissolved gas, which causes the values to be too high; as for the influence of temperature, the whole curve may be checked by using a graph of log P against $1/T^\circ$; divergences greater than 1 % should not be accepted.

c) The *critical temperature and pressure* are very sensitive to the presence of impurities; only contemporary values are concordant to ± 0.05° (work of the Dutch physico-chemical school, measurements made by YOUNG, CARDOSO and the American investigators).

The critical volume and density can hardly be determined to about 0.001 except indirectly by using the rule of the rectilinear diameter.

The *critical constants* are extremely sensitive criteria of purity both as absolute values and also owing to the considerable variations which they undergo in the course of systematic fractionation of an impure sample; this criterion of purity plays a very important part in the study of substances which are gaseous at ordinary temperature.

---

[1] W. SWIETOSLAWSKI, *Ebulliometric Measurements*. New York, 1945.
[2] L. GILLO, *Bull. soc. chim. Belg.*, 48 (1939) 341.
[3] S. YOUNG, *J. chim. phys.*, 14 (1906) 434.

The *critical solution point* (t°.cr.s.) in a suitable solvent, is also a criterion of purity which is often useful in the study of organic liquids (Crismer index).

d) The *freezing or melting point* is a very useful criterion of homogeneity. When the freezing range is greater than one tenth of a degree, we have considered the sample as impure. During recent years, the National Bureau of Standards of Washington has brought into use a method of determination of the exact amount of impurities in a sample (up to 1 in 100,000) from a study of the complete freezing curve measured to 0.0001° [1].

The absolute value of the freezing point should be known to about 0.1°. The variation of the melting point as a function of high pressure has been determined with sufficient accuracy by Bridgman and Deffet only.

B. CONSTANTS OF HOMOGENEOUS PHASES

a) The *constants of state* (with their temperature coefficients) give numerical characteristics of the various physical states of each substance (vapour, liquid, crystal).

The *specific weight* referred to its value in vacuo, should be known to within at least 0.02 %.

The absolute values of the *viscosity* are difficult to measure with an accuracy greater than 1 % (too high values recorded in the literature are often due to turbulent flow).

The *surface tension* is difficult to measure with an accuracy greater than about 0.2 %. (Harkins alone has succeeded in measuring surface tension by methods other than that of capillary rise).

The *refractive index* for different wavelengths can hardly be determined at present with an accuracy greater than the fourth decimal. We may hope for better agreement when the method of comparative measurement elaborated by Smith is in general use.

The *dielectric constant* is rarely known within less than about 0.1 %.

The *specific rotatory power* and the *magnetic susceptibility* of pure organic compounds have been determined with accuracy in a very small number of cases; only Perkin has measured the *magnetic rotatory power*, giving at the same time sufficient details to allow of an appreciation of the accuracy attained.

The majority of these constants have been determined, without ambiguity and with sufficient precision, for the liquid state only. For most gases, measurements of refractive index, dielectric constant and specific heat have been carried out by physicists on samples of which the purity cannot be estimated and by using methods whose results are not very concordant; only the studies of the weight of the normal litre, of the coefficients of compressibility and expansion, and of isothermals, have given entirely satisfactory results.

---

[1] A. R. Glasgow Jr., J. Streiff and F. D. Rossini, *J. Research Nat. Bur. Standards*, 35 (1945) 355. F. W. Schwab and E. Wickers, *J. Research Nat. Bur. Standards*, 34 (1945) 333.

In the vitreous or crystalline state, most of the constants have been determined on poorly defined samples from which the dissolved gas had not been carefully expelled; only very few of these densities can be accepted (on this subject see the very pertinent remarks of E. COHEN) [1].

The invariability of suitable constants of state, confirmed on different portions of a sample which has been submitted to systematic fractionation, has often been used as a criterion of purity.

b) The *heat constants* (specific heat, latent heat of transformation, heat of combustion).

The *mean specific heat* between two temperatures has been rejected; only contemporary measurements in which the specific heat has been determined for each temperature have been retained (results of the American school); in this case especially the physical state of the samples (liquid, glass, polymorphous forms) should be carefully defined.

Except in a few special cases, the specific heat of the crystalline phase is lower than that of the corresponding liquid phase; if the specific heat of the crystals rises rapidly when approaching the melting point, the sample may generally be considered as impure; but this criterion of purity is so sensitive that up to the present it has always been at fault when the measurements were sufficiently near the melting point (see E. L. SKAU) [2].

Note that too high a value for the specific heat of the crystals corresponds to too low a value for the latent heat of fusion.

The heat of combustion has been expressed, as far as possible, in calories at 15° per gram of substance weighed in vacuo; only the results of the last twenty years have been retained, because they alone have been determined by comparison with the international calorimetric standard: the benzoic acid of the National Bureau of Standards of Washington.

C. CHEMICAL CRITERIA OF PURITY

In former days, many chemical reactions were used to reveal the presence of impurities in organic compounds, but it must be recognized that the sensitiveness and specificity of these reactions are generally insufficient. It is however possible to improve some of these methods so as to demonstrate the presence of such small traces of impurities that they have no influence on the values of physical constants measured with the usual accuracy (see the researches of GILLO).

---

[1] E. COHEN, *Z. physik Chem.*, 150 A (1930) 418. (Regarding chemical and physical purity).

[2] E. L. SKAU, *Bull. soc. chim. Belg.*, 43 (1934) 287.

3. RULES EMPLOYED TO ASSESS THE ACCURACY AND PRECISION OF THE PUBLISHED VALUES OF CONSTANTS

These rules refer to three different sets of considerations.

A. AUTHENTICITY OF PUBLISHED VALUES

When consulting a treatise of historical criticism, one realizes that the largest part of the work concerns the degree of authenticity of the written sources of information, which are often transmitted in a form very different from that of the original text. This question practically never arises for us, since the publications, of which we discuss the contents, are accessible as works printed under the direct control of the author. The only important point, in this respect, is the existence of misprints, unnoticed by the proof reader, and of errors or omissions due to faulty editing of the original paper. For example: RICHARDS and MATHEWS, in a paper concerning surface tensions at 30°, give values of the density at 20°; a comparison of their values with those of other authors shows that the measurements of density have very probably been made at 30° like those of surface tension quoted in the next column of their table of experimental results.

On the other hand, the exactness of many measurements of temperature, for instance, cannot always be estimated with accuracy, because the author does not indicate whether or not he has applied the necessary correction for the emergent column; and again for densities, because he does not state whether or not he is giving values reduced to vacuo, values at t°/t° or at t°/4°, and so on.

B. INTRINSIC CRITERIA

These criteria permit of a direct appreciation of the value of the work in itself. They result from the considerations given in paragraph 2 concerning the purity of the samples, combined with an appreciation of the precision of the physical methods used by the author.

a) If the *origin of the samples* or their *method of purification* does not assure the purity of the compound, all the constants given for that sample are evidently of little value. This is the case, for instance, with the saturated hydrocarbons of the fatty series prepared by simple fractionation of mineral oils. Only S. YOUNG, later CHAVANNE in Brussels and WASHBURN in Washington, have succeeded in preparing pure pentane and hexane in this way, but the fractionation took several months of work. Subsequently, the National Bureau of Standards of Washington, in collaboration with the American Petroleum Institute, has perfected these methods so as to make them less tedious. Similarly, chloroform gives exact physical constants only if it is examined immediately after distillation over phosphorus pentoxide: simple fractionation of the medicinal product gives merely the azeotrope with alcohol, and when this stabiliser is removed the chloroform, in contact with air, oxidises rapidly.

b) When the value of one of the principal constants indicates that a sample is impure, all other constants of the same sample must be rejected.

This happens, for example, when the samples do not distil at constant temperature or when their density is notoriously inaccurate. In fact, one may well believe that an author who is unable to measure exactly the density—a relatively simple operation—is not likely to show any aptitude in overcoming much greater difficulties in the measurement of, for example, a dielectric constant. Conversely, if his determination of density is accurate, the impurity of the sample is proved beyond doubt.

c) But inaccurate figures for some of the constants of a sample of a pure compound do not always necessitate the rejection of the other constants given for the same sample. Anomalies of this kind occur if the calibration of an instrument has been done by means of inaccurate standards—e.g., the thermometric scale above 100° accepted by KAHLBAUM of Basle and his pupils is definitely too low —or if the author has neglected a correction which is indispensable if the desired degree of precision is to be attained—e.g., the correction for turbulence in the measurement of viscosity performed with capillaries of too great a diameter; for this reason, all such results of KASSEL and SCHEUER are too high.

d) It is possible to judge the accuracy of certain numerical data, which are not directly comparable with each other, by referring them to similar conditions by means of suitable formulae or diagrams. Thus, at temperatures appreciably below the boiling point at normal pressure, the variation of the density of a liquid is linear, within about 0.01 %, for an interval of 20 to 30 degrees. It is precisely in order to permit of the comparison of measurements, executed at different temperatures, that we make a point, at the International Bureau of Standards of Brussels, of determining the temperature coefficients of those constants.

e) Further, one can detect immediately the erratic behaviour of certain groups of results by means of suitable graphs; such are: the dispersion, by plotting the refractive index as a function of the inverse square of the wavelength; or the curve of saturated vapour pressure, with the logarithms of the pressure as ordinates and the inverse of the absolute temperatures as abscissae.

C. CRITERIA OF COMPARISON

Here the results of measurements of the same constant, carried out by different authors, are compared.

a) The *concordance of the values* given by several authors, observed on samples of diverse origin and with different apparatus, is generally an evidence of correctness, for truth alone is unique, while error is manifold. But one ought to make sure that these concordant results have not been determined on the same sample of substance which has passed from hand to hand; or again that the new data are not just a copy of results published previously. Thus the samples of *iso*amyl compounds which were used in the investigations of LANDOLT and of his collaborators on the dielectric constant and the magnetic rotatory power were all the same; accordingly the absolute agreement of densities given by this series of investigators cannot be considered as a confirmation of their exactness.

b) The personality of the author also plays a part; has he generally shown evidence of a critical outlook in the choice of the method of purification of his samples and in the evaluation of the degree of precision of his physical methods? One should not fear too much modesty on this point; COLLARDEAU[1] has shown that REGNAULT himself enormously exaggerated the precision of his determinations of coefficients of expansion of gases.

With regard, for instance, to surface tension, all the measurements of some laboratories, executed by the stalagmometric method, are tainted with systematic errors.

c) The measurements of a specialist are of infinitely more weight than those of a newcomer or of one of those observers who have acquired the unfortunate reputation of filling the periodicals with premature publications. Again an author, who is well known for his researches on viscosity, would not indeed appear to be worthy of any confidence, when it is found that he is generally in disagreement with other specialists such as THORPE, and further, when he gives, and without mentioning the divergence to the reader, such different values for the viscosity of benzene at 25° as:

$$\eta \cdot 10^5 = 582 \ (1904),\ 598 \ (1905) \text{ and } 614 \ (1908).$$

d) At the same time the results of systematic research on a particular constant are much preferable to values determined incidentally during the course of work on a different object; in his fine papers, WALDEN gives the freezing point below 0° of a large number of organic compounds; in spite of the well-deserved reputation of their author, these values do not offer any guarantee, because he has evidently used an inaccurate scale of temperature, neglecting the correction for the emergent stem of his thermometer, so that his freezing points below the ice point are much too high. It should be noted here that if the freezing point to be measured is below 0°, this correction is negative and consequently the freezing point given by the author will be much too high and, in distinction to the usual case, here the best melting points are the lowest and not the highest ones.

---

[1] E. COLLARDEAU, *Les approximations dans les mesures physiques.* 1 Vol. 8$^{\text{vo}}$. Paris, 1906.

e) Finally, all other considerations being put aside, the most recent work is more likely to be the best: results prior to 1900 are rarely useful except when they derive from classical authors such as Perkin, Young, Thorpe, Brühl, etc. It is necessary however to make sure that the contemporary author is up to date with the subject, since, in the domain of pure compounds, results proving an inconceivable ignorance of previous work are published every day; many authors, including Ramsay in 1910, have used sodium for dehydrating ethyl alcohol, and lime for methyl alcohol, although it had been shown by Crismer in 1907, by means of the critical solution temperature test, that in both these cases an equilibrium was established between alcoholate and hydrate and that therefore the dehydration of alcohol was incomplete by such methods.

4. ARRANGEMENT OF THE TEXT

A. ORDER OF THE COMPOUNDS

The substances are arranged according to their composition and their chemical function; first all the acyclic hydrocarbons, saturated and unsaturated; then the aromatic hydrocarbons and the polymethylenes (*cyclo*paraffins); further on, the halogenated derivatives in the same order; the oxygenated derivatives (alcohols and ethers, aldehydes and ketones, acids and esters), the nitrogen compounds (amines, nitriles, nitro derivatives, amides, etc.), mixed compounds (oxyhalogenated, nitrohalogenated compounds, etc.), and finally sulphur and phosphorus derivatives, etc.

In each group, the compounds of the aliphatic series come first, then those of the aromatic and polymethylene series with heterocyclic derivatives at the end. For some compounds where comparative data are scarce, we merely refer to the literature (small text).

B. ORDER OF SUBJECT MATTER

For each compound, general considerations on the method of purification are followed by criteria of purity and bibliographical sources. We note always whether the compound has been the subject of a publication by the International Bureau of Standards of Brussels. The constants studied are always placed in the same order: constants of heterogeneous equilibrium, then constants in the vapour, the liquid and the crystalline state, and finally heat constants.

C. NUMERICAL VALUES GIVEN

For each constant, there are given all the values which have not been eliminated by using our intrinsic criteria and which do not differ too much from the most probable values given by recognised specialists. When reliable comparative data are lacking, figures showing a sufficient degree of agreement are retained; this however is somewhat rare.

One will not be surprised to see frequently quoted the data of the International Bureau of Standards (B.E., for Bureau d'Etalons) of Brussels, as that laboratory has specialised in that kind of work for twenty-five years, but there has been no hesitation in rejecting the data of this laboratory when later work has shown its inaccuracy.

D. BIBLIOGRAPHICAL REFERENCES

The origin of the numerical data in the text is shown by bibliographical references with the name of the author and the date of publication. These refer to the bibliography at the end of the work.

E. BIBLIOGRAPHICAL TABLE

This table gives all the original works quoted in the text in the alphabetical order of the authors and the seniority of their publications; it contains some notes on the value of such and such particular work, and is prefaced by a short historical review of the subject.

F. TABLE OF FORMULAE

This table contains the empirical formulae and the names of all the substances measured, classified according to the order adopted in the tables of *Chemical Abstracts,* published by the American Chemical Society.

5. NOTES CONCERNING SYMBOLS AND UNITS

A. SYMBOLS

The chemical compounds are represented by their formulae and their names; these are also given in the table of formulae at the end of the book.

Below, the symbols which are used in this work are listed. Their choice is derived from the conclusions of the International Commission for the Unification of Physico-chemical Symbols (*Z. Electrochem.*, 27 (1921) 527), and as far as possible it takes into account the recommendations of the "Report on Symbols for Thermodynamic and Physico-chemical Quantities, and Conventions Relating to their Use" (*Trans. Chem. Soc.*, (1937) 2091) which has recently been amended by the XIVth Conference of the International Union of Chemistry (London, July, 1947).

Physical constants

Degrees (Centigrade)	t°	Atmospheres	atm
Degrees (Kelvin)	T°	Kilogram/cm^2	kg/cm^2
Pressure	p	C.G.S. units	C.G.S.
Millimetres of mercury	mm		

Polyphasic equilibria

Liquid	L.	Saturated vapour pressure	p_v
Gas	G.	Melting or freezing point	M.P.
Vapour	V.	Transition point	Tr. P.
Solid	S.	Boiling point	B.P.
Crystal	C.	Critical point	t°cr
Critical constants	cr.	Critical solution point	t° cr. s.

Heat constants

Calorie	cal
Specific heat or heat of combustion at constant volume	c_v
Specific heat or heat of combustion at constant pressure	c_p

Constants of state

Density	d	Dielectric constant	ε
Viscosity	η	Rotatory power	α
Surface tension	γ	Magnetic susceptibility	χ
Refractive index	n	„ rotatory power	μ

B. UNITS

In order to facilitate the use of this work we have been careful to reduce the results of different authors to the same system of units, where this has appeared to be useful; below will be found some comments on this subject.

a) 0° *of the centrigrade scale of temperature*

The temperatures are expressed sometimes in Centigrade degrees (t°), sometimes in absolute degrees (T°). Unfortunately, a factor of uncertainty about the correspondence of these two scales results from the disagreement which has existed for a long time with regard to the exact value of the zero point of the Centigrade scale on the absolute scale. German publications generally accept the value 0° t = 273.18° T of the Physikalisch-Technische Reichsanstalt of Charlottenburg, recognised by German law (see L. Holborn, K. Scheel, and F. Henning, *Wärmetabellen*, 1919, p. 7). The Dutch school uses the scale of the Cryogenic Laboratory at Leyden, on which the zero point is at 273.12° T. The American school, on the contrary, makes use of the scale of the National Bureau of Standards:

0° t = 273.16° T. It is necessary to take into account these differences when comparing results of authors from different countries; fortunately subsequent researches have led to agreement on an intermediate value of 273.15° T. (Report of the 7th International Congress on Cold, The Hague, 1937, and Decisions of the 8th Conference of the International Bureau of Weights and Measures at Sèvres, in October 1948: 0° t = 273.15° T).

b) *International Scale of Temperature*

Thanks to the initiative of the International Bureau of Weights and Measures of Sèvres [1], the chief laboratories interested in that matter have agreed on an empirical and provisional definition of the International Scale of Temperature. This scale is defined from two different points of view: by adoption of some fixed points of reference and by interpolation formulae for the intermediate regions, with the aid of the platinum resistance thermometer. In addition, some secondary fixed points have been accepted; their value is given below so far as they are useful for us.

Fundamental fixed points of the International Scale of Temperature

1) Temperature of equilibrium between liquid and gaseous oxygen at a pressure of a standard atmosphere (boiling point of oxygen: −182.97°)

$$t_p = t_{760} + \frac{21.94 \lg \frac{p}{po}}{1 - 0.261 \lg \frac{p}{po}}$$

2) Temperature of equilibrium between ice and water, saturated with air, at a pressure of a standard atmosphere (melting point of ice: 0°). This temperature is at present defined as being 0.0100° lower than the triple point of water.

3) Temperature of equilibrium between liquid water and its vapour at a pressure of a standard atmosphere (boiling point of water: 100°)

$$t_p = t_{760} + \frac{64{,}5 \lg \frac{p}{po}}{1 - 0.1979 \lg \frac{p}{po}}$$

4) Temperature of equilibrium between liquid sulphur and its vapour at a pressure of a standard atmosphere (boiling point of sulphur: 444.60°)

$$t_p = t_{760} + \frac{158.92 \lg \frac{p}{po}}{1 - 0.234 \lg \frac{p}{po}}$$

c) *Secondary fixed points at low temperatures*

This agreement will doubtless lead in the future to greater homogeneity between the results of authors of different countries, but for those which are already recorded in the literature, there are certain peculiarities to which attention should be drawn: side by side with some very recent measurements in which use has been made of the International Scale defined as above, the majority of the values for temperature given in this work, are based on a series of standard points, which were used for the calibration of the thermometers and which do not always agree exactly with the values deduced from the above International Scale; the differences are, however, in general negligible.

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[1] *Comptes Rendus, 9th Conference* Paris (1948) 32—49.

Temperatures below 0°: the numerous results of TIMMERMANS are reported on a scale determined by the following fixed points:

Substance	Old scale (1912)	Corrected scale (1922)	Scale of the National Bureau of Standards (1947)
CCl_4	−22.95	−22.85	—
C_2H_5Cl	−45.0	−45.2	—
$CHCl_3$	−63.3	−63.4	—
$CH_3CO_2C_2H_5$	−83.4	−83.6	—
$C_6H_5CH_3$	−94.5 (*)	−95.1	−94.991
CS_2	−111.6	−111.85	—
$C_2H_5OC_2H_5$ (a)	−116.2	−116.3	—
(b)	−123.3	−123.3	—
$C_6H_{11}CH_3$	−126.4	−126.35	−126.57
C_5H_{12}*iso*	−158.05 (*)	−160.0	−159.890

N.B. There is no important difference except for toluene and *iso*pentane. The measurements of TIMMERMANS *et al.*, using the hydrogen thermometer scale of the cryogenic laboratory at Leyden [1], and the determinations of SKAU (*J. Phys. Chem.*, 37 (1933) 609) which were made on a thermocouple scale, give slightly different values. In order to avoid any confusion, all the results of TIMMERMANS have been expressed on his old scale, without later corrections.

d) *Secondary standards above 0°*

Between 0° and 160° other difficulties appear (see Annexe II of the Report of the International Bureau of Physico-chemical Standards for the period 1936—1937, presented to the XIIth Conference of the International Union of Chemistry at Rome in May 1938).

At the International Bureau of Physico-chemical Standards, the secondary standards, which we used, are the boiling points of pure organic substances which were determined with the greatest care by RAMSAY and YOUNG on the air thermometer scale some 50 years ago; until now the values adopted were considered as exact and reproducible to about 0°05, and were the standards generally adopted.

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[1] J. TIMMERMANS, *Communications, Leyden,* Supplements 51b (1924), 64a (1928). J. TIMMERMANS, H. VAN DER HORST and H. KAMERLINGH ONNES, *Compt. rend.*, 174 (1927) 368; *Arch. Néerl.* III A, 6 (1922) 1180 and *Communications, Leyden,* No. 157 (1922).

During recent years, Zmaczynski, Wojciechowski, Bylewski, Swietoslawski, on the one hand, and a number of American scientists working at the National Bureau of Standards on the other (Mair, Bruun, Smith, and Matheson) have moreover measured the boiling point of the same compounds, using the resistance thermometer, and samples of the compounds which had been carefully purified and of which the constants (density and refractive index) coincided with those of the samples of the "International Bureau of Standards"; in certain cases, the authors even used samples provided by our laboratory. Generally, the values found by these authors for the boiling points are slightly lower than those which we have adopted. In the most unfavourable case (normal butyl alcohol) the divergence is as much as 0.28°.

The following table summarizes these observations

	S. Young		Nat. Bur. Stand.		Swietoslawski	
Compounds	t°	$\frac{dt}{dp}$	t°	$\frac{dt}{dp}$	t°	$\frac{dt}{dp}$
C_5H_{12}	27.95	0.37	27.854	0.381	—	—
C_2H_5Br	38.40	0.36	—	—	38.402	—
CS_2	46.25	0.42	—	—	46.270	—
$CHCl_3$	61.20	0.38	—	—	—	—
CCl_4	76.75	0.44	—	—	76.786	—
C_6H_6	80.20	0.43	80.101	0.427	80.110	—
H_2O	100.00	0.37	100.00	0.367	100.00	0.3666
$C_6H_5CH_3$	110.80	0.42	110.625	0.463	(110.615)	—
C_6H_5Cl	132.00	0.49	—	—	131.842	—
C_6H_5Br	156.15	0.53	—	—	156.010	—
$C_6H_5NH_2$	184.40	0.51	—	—	—	—
$C_6H_5NO_2$	210.85	0.48	—	—	—	—
$C_{10}H_8$	218.00	0.58	—	—	—	—

S. Young (1910); B.J. Mair(1932); M. Wojciechowski (1936—37); M. Wojciechowski and E. Smith (1937); A. Zmaczinski (1930—36); W. Swietoslawski (1934); T. Bylewski (1932); M. M. Hicks-Bruun and J. H. Bruun (1932); E. R. Smith and H. Matheson (1938). N.B. The value in parentheses is less certain than the others.

e) *Calorific values*

These values are always expressed in cal (usually cal 15°): the heats of combustion expressed in joules by the National Bureau of Standards have been converted to calories by using as conversion factor:

1 International Joule = 1.00032 absolute joules
1 cal 15° = 4.185 absolute joules
See National Bureau of Standards (1947).

The heats of combustion, expressed at constant volume or pressure per g of substance weighed in vacuo, have only been retained from measurements performed after 1921, since benzoic acid was only adopted as thermochemical standard at the IIIrd Meeting of the International Union of Chemistry at Lyons in 1922. The values given by the IVth and the XIIth Conferences (1922—1928) for the heat of combustion of pure benzoic acid are as follows:

0°	6323.3 cal 15°	18°	6319.4 cal 15°
15°	6320.1 „	19°	6319.2 „
16°	6319.9 „	20°	6319.0 „
17°	6319.6 „	21°	6318.8 „

In addition, the XIIIth Conference (Zürich 1936) adopted as secondary thermochemical standard succinic acid, for which the heat of isothermal combustion at 20° is 3025.5 cal 15°.

Roth and Lamprecht (1938) have made a further revision of the heats of combustion of benzoic and succinic acids, but their agreement with the standard value is not perfect.

f) *Other units*

Viscosity (η): the centipoise represents 10^{-2} C. G. S. units.

Surface tension (γ): always expressed in dynes per cm^2.

Rotatory power and magnetic susceptibility expressed in specific units, *i.e.* per g of substance.

Heat constants are always specific and not molecular values; in case of reduction of the second one to the first, we have used, so far as possible, the molecular weights given by the authors themselves (value in brackets); or else we accept the following values of the atomic weights:

C	12.000	F	19.000
H	1.0078	Cl	35.456
O	16.000	Br	79.92
S	32.06	I	126.92
N	14.008	P	31.04

In the Project No. 44 of the Researches sponsored by the American Petroleum Institute, and carried out at the National Bureau of Standards at Washington, tables of spectra of hydrocarbons (Raman, infra-red, ultra-violet, and mass spectra) are collected. These tables have not been reproduced in the present work.

TABLES

1. HYDROCARBONS

The hydrocarbons and in particular the paraffins and benzene are a first rate physico-chemical material. Accordingly, their constants have been the subject of a very great number of determinations; nevertheless, many of their physical constants are not yet known with the accuracy desirable.

A. PARAFFINS

METHANE CH_4

Bibliography: Malisoff and Egloff (1918)

It is rather amazing to find that the exact values of the physical constants of methane have not yet been determined. In fact, very few results can be accepted as data worthy of contemporary science; this is due, on the one hand, to the impurity of the gas yielded by old methods of preparation and, on the other hand, to the uncertainty of the low temperature scale used in many cases.

Preparation of methane in the pure state: Baume and Perrot (1909)

Six methods have been used for the preparation of methane:

1°) Calcination of a mixture of sodium acetate and sodium hydroxide.
2°) Decomposition by water of organo-magnesium compounds formed from methyl halides.
3°) Action of zinc-copper couple on methyl iodide.
4°) Action of methyl iodide on sodium ammonium.
5°) Decomposition of aluminium carbide by water.
6°) Action of metallic sodium on acetonitrile.

The first, second and third methods produce methane with impurities whose complete elimination is very difficult (ethane, ethylene, acetone, etc.). The fourth and fifth methods produce methane which is easier to purify (water vapour, ammonia, etc.). Only the sixth method gives directly a very pure gas.

Moreover, air is very soluble in liquid methane and escapes during freezing; and is therefore easy to eliminate completely. In any case, the purification must be completed by very narrow fractional distillations.

The best criteria of purity are the constancy of the saturated vapour pressure during the isothermal liquefaction, the constancy of the freezing point along the freezing curve and, finally, the value of the critical constants. At present, industry produces methane which is approximately pure.

Constants. — Polyphasic equilibria

Critical constants: Survey by PICKERING (1924) — t.°cr: Still not known with a sufficient degree of accuracy; the gas used by CARDOSO (1913—15) was very pure but unfortunately his thermometric scale was unreliable in that temperature region.

p cr.atm.	d cr.	
45.60	0.1623	CARDOSO (1913—15)

Saturated vapour pressure: the values given by CARDOSO are unreliable owing to his temperature scale; the best values have been obtained by HENNING and STOCK (1921) or STOCK, HENNING and KUSZ (1921)

t°	p mm	t°	p mm	
−161.37	760	−173.49	249.4	HENNING and STOCK (1921)
−162.45	691.1	−181.87	94.2	,,
−164.77	570.9	−186.67	46.7 C.	,,
−170.49	536.6	−192.89	16.0 C.	,,

Triple point (p mm)	87.4	FRANK and CLUSIUS (1937)
	87.5	CLUSIUS and POPP (1940)
	87.75	STAVELEY and GUPTA (1949)
Melting point	−182°49	CLUSIUS (1929) and CLUSIUS and WEIGAND (1940)
	−182°52	CLUSIUS and POPP (1940)
Transition point	−252°66	CLUSIUS (1929) and CLUSIUS and WEIGAND (1940)
	−252°74	CLUSIUS and POPP (1940)

Melting curve: CLUSIUS and WEIGAND (1940)

t°	p atm.	t°	p atm.	t°	p atm.
−178.53	155.6	−180.01	96.2	−181.22	48.3
−178.78	145.8	−180.25	86.8	−181.46	39.0
−179.02	136.25	−180.50	77.1	−181.75	28.8
−179.28	126.3	−180.75	67.2	−181.95	20.7
−179.54	115.3	−180.98	58.2	−182.23	9.5
−179.16	106.9	−180.98	58.0	−182.49	0.115 (87.4 mm)

Weight of the normal litre in the gaseous state: 0.7168 g BAUME and PERROT (1909)

Isotherms

Keyes and Burks, (1927) (between 0° and 200° and from 30 to 250 atm.)
Kvalnes and Gaddy, (1931) (between −70° and +200° and from 1 to 1000 atm.)
Michels and Nederbragt, (1935—36) (between 0° and 150° and until 80 atm.)

Heat constants

Specific heat: Clusius (1929) and Clusius and Perlick (1934)

t°	c_p	t°	c_p	t°	c_p
C. I −262.77	0.05951	−254.28	0.3196	−214.8	0.5284
−262.32	0.06606	−253.95	0.3613	−211.7	0.5410
−262.12	0.06974	−253.43	0.4474	−208.0	0.5498
−261.75	0.07261	−253.17	0.5374	−205.9	0.5583
−261.12	0.08003	−252.89	0.8303	−204.5	0.5634
−261.04	0.08602	−252.62	2.5263	−202.4	0.5724
−260.77	0.08820	−252.62	3.0403	−201.2	0.5771
−260.02	0.1072	C. II −252.24	0.7529	−198.1	0.5852
−259.91	0.1156	−252.16	0.6224	−197.5	0.5926
−259.62	0.1180	−250.30	0.2881	−193.7	0.6026
−258.92	0.1275	−248.2	0.3076	−193.6	0.6060
−258.65	0.1380	−246.4	0.3289	−190.1	0.6217
−258.06	0.1460	−244.6	0.3453	−189.4	0.6250
−257.69	0.1578	−242.4	0.3637	−186.1	0.6313
−257.22	0.1815	−237.9	0.3987	−185.9	0.6356
−257.16	0.1773	−235.1	0.4324	L. −177.7	0.7991
−256.19	0.2004	−228.7	0.4593	−175.4	0.8016
−255.85	0.2202	−226.4	0.4711	−174.2	0.8047
−255.83	0.2239	−223.4	0.4884	−171.1	0.8090
−255.23	0.2517	−220.6	0.5026	−167.8	0.8115
−254.36	0.3184	−217.4	0.5149		

Heat of vaporisation	126.9 cal 15°/g at 246.1 mm (−173°56 according to Henning and Stock)	Frank and Clusius (1937—39)
Heat of melting	13.973 cal 15°/g at −182°49	Clusius (1929)
	13.964 „	Clusius and Popp (1940) (M. W. 16.041)
Heat of transition	1.13 cal 15°/g at —252°66	Clusius (1929)
	0.978 „	Clusius and Popp (1940)
Heat of combustion	13267 cal 15°/g at 30° (c_p)	Rossini (1931) (corr.)

DEUTEROMETHANE CD_4

Constants: Clusius and Popp (1940) (M. W. used: 20.0624)

Melting point: −183°38

Transition points: II → I −246°06; III → II −250°91

Triple point: 78.9 mm

Melting curve

t°	p atm.	t°	p atm.	t°	p atm.	t°	p atm.
−179.21	168.25	−181.00	94.5	−181.69	67.1	−183.39	39.6
−179.49	156.7	−181.07	91.9	−181.71	66.2	−183.43	38.2
−179.85	142.5	−181.20	86.3	−181.93	57.6	−183.67	28.2
−180.16	128.75	−181.21	86.1	−182.95	56.6	−183.90	18.9
−180.46	117.0	−181.24	85.6	−183.18	47.85	−184.17	8.4
−180.68	107.65	−181.45	76.6	−183.19	47.6	−184.38	0.104
−180.98	95.0	−181.46	76.35				

Specific heat

t°	c_p	t°	c_p	t°	c_p
C. III −261.98	0.06729	−250.24	0.44062	−243.25	0.37682
−261.65	0.06878	−250.02	0.32150	−242.03	0.3808
−259.78	0.08822	−249.84	0.32748	−241.63	0.38280
−258.82	0.09969	−248.92	0.39377	−239.18	0.39028
−257.99	0.11564	−248.68	0.39925	−238.72	0.3878
−257.49	0.12660	−248.59	0.39975	−237.69	0.39377
−256.37	0.14656	−247.95	0.46206	−234.66	0.40673
−256.09	0.15352	−247.59	0.52187	−230.36	0.42268
−255.52	0.16548	−247.37	0.56324	−227.12	0.43564
−254.58	0.19539	−246.86	0.70031	−223.47	0.44511
−254.48	0.19688	−246.72	0.81744	−220.07	0.45159
−253.96	0.21134	−246.62	0.82941	−216.46	0.46256
−253.76	0.21533	−246.57	0.90717	−208.79	0.47851
−252.82	0.25421	−246.34	1.4455	−196.88	0.50243
−251.47	0.36125	−246.31	1.4554	−192.71	0.51140
−251.16	1.4854	−246.24	1.7994	−189.26	0.51788
−251.06	2.1134	−246.16	3.2000	−188.63	0.51988
−251.04	4.6505	−246.11	3.6037	L. −181.04	0.67190
−251.01	5.6872	C. I −246.02	1.9958	−179.43	0.6739
−251.01	6.3203	−245.74	0.60412	−178.14	0.6749
C. II −250.95	2.8262	−245.69	0.56224	−173.08	0.68087
−250.81	1.0916	−245.08	0.39726	−168.49	0.68387
−250.29	0.50443	−244.49	0.38480	−164.22	0.68735

Heat of melting	*Heats of transition*	
10.751 cal 15°/g	II → I 2.926 cal 15°/g	III → II 0.9869 cal 15°/g

MONODEUTEROMETHANE CH_3D

Constants: Clusius and Popp (1940) (M. W. used: 17.0390)

Melting point: −182°74

Triple point: 84.5 mm

Transition points: II → I −249°97; III → II −257°28

Melting curve

t°	p atm.	t°	p atm.	t°	p atm.	t°	p atm.
−180.76	77.5	−181.17	61.5	−181.57	46.1	−182.17	22.65
−180.97	69.4	−181.18	61.3	−181.76	38.2	−182.33	16.6
−181.01	68.3	−181.37	53.7	−181.94	31.1	−182.41	12.8

Specific heat

t°	c_p	t°	c_p	t°	c_p
C. III −261.80	0.0599	−251.28	0.430	−233.90	0.407
−261.31	0.0604	−250.84	0.568	−232.68	0.417
260.31	0.0775	−250.57	0.582	−231.71	0.422
−260.06	0.0857	−250.50	0.6960	−229.47	0.435
−258.66	0.133	250.35	0.7835	−227.13	0.449
−258.41	0.145	−250.14	2.148	−224.39	0.464
−257.78	0.257	−250.13	2.764	−221.80	0.472
−257.64	0.472	−250.11	3.404	−218.34	0.485
−257.61	0.569	−250.02	3.727	−217.00	0.492
−257.51	0.998	−250.02	4.038	−215.36	0.495
−257.46	1.673	−250.02	6.849	−209.13	0.520
−257.40	2.418	C. I −249.71	0.6151	−204.01	0.536
C. II −257.28	1.027	−249.33	0.335	−200.74	0.552
−257.27	0.878	−248.66	0.318	−194.48	0.565
−257.17	0.529	−248.10	0.317	−189.77	0.587
−257.11	0.245	−247.55	0.322	−186.70	0.595
−256.46	0.167	−246.52	0.329	L. −180.70	0.7600
−255.51	0.189	−245.75	0.331	−180.66	0.7629
−255.36	0.194	−243.56	0.345	−176.79	0.7665
−255.06	0.201	−241.28	0.358	−176.25	0.7723
−254.16	0.229	−239.68	0.370	−175.98	0.7747
−253.44	0.265	−238.27	0.378	−175.43	0.7847
−253.09	0.282	−237.92	0.381	−172.84	0.7929
−252.02	0.359	−236.78	0.390		
−251.67	0.386	−235.66	0.396		

Heat of melting	*Heats of transition*	
12.76 cal 15°/g	II → I: 2.61 cal 15°/g	III → II: 0.798 cal 15°/g

ETHANE C_2H_6

The purification of this gas is as difficult as that of methane. Method No. 6 gives the best results (Cardoso and Bell, 1912).

The equation of state of ethane has been the subject of a critical survey by Sage, Webster and Lacey (1937).

Constants

Critical constants: Survey by Pickering (1924)

t° cr.	p cr. atm.	
32.1	48.6	Lu, Newitt and Ruhemann (1941)
32.10	48.85	Cardoso and Bell (1912)
32.27	48.20	Beattie, Su and Simard (1939)

Saturated vapour pressure

t°	p atm.	t°	p atm.	t°	p atm.	
−137.424	0.0245	−97.452	0.6073	−85.858	1.1619	Loomis and Walters (1926)
−129.893	0.0522	−95.437	0.6804	−85.334	1.1881	,,
−125.836	0.0762	−94.539	0.7210	−84.781	1.2289	,,
−118.704	0.1400	−93.410	0.7696	−84.046	1.2761	,,
−114.775	0.1886	−91.654	0.8499	−83.302	1.3264	,,
−110.531	0.2573	−90.697	0.8963	−82.469	1.3900	,,
−107.631	0.3160	−89.382	0.9634	−81.730	1.4347	,,
−105.224	0.3693	−88.521	1.0040	−80.874	1.4974	,,
−103.985	0.4033	−88.023	1.0366	−80.383	1.5340	,,
−101.460	0.4743	−87.146	1.0800	−76.916	1.8110	,,
−103.558	0.4430	−86.551	1.1208	−73.251	2.1441	,,
− 99.098	0.5498					,,
−88.69	0.9924	−46.98	6.073	−9.88	18.448	Porter (1926)
−69.67	2.496	−38.58	8.044	−4.43	21.185	,,
−67.54	2.733	−35.26	9.229	−0.07	23.544	,,
−62.20	3.414	−29.94	10.536	+5.68	26.837	,,
−56.85	4.225	−24.51	12.354	10.42	30.106	,,
−51.28	5.207	−20.13	14.043	15.10	33.468	,,
−48.06	5.838	−14.36	16.421			,,
0	23.57	25	41.37	—	—	Beattie, Hadlock and Poffenberger (1935)

Boiling point

−88°62	Porter (1926)
−88°633	Loomis and Walters (1926)

Melting curve

t°	p atm.	t°	p atm.	
−182.81	0.001	−182.42	24.6	Clusius and Weigand (1940)
−182.71	6.1	−182.33	30.3	„
−182.59	13.2	−182.23	36.5	„
−182.52	18.7	−182.13	42.1	„

Weight of the normal litre in the gaseous state: 1.3562 g Baume and Perrot (1909)

Isotherms

Beattie, Hadlock and Poffenberger (1935): (0.5 to 5 atm.; 25° to 250°)
Sage, Webster and Lacey (1937): (21° to 125°; until 250 kg)
Beattie, Su and Simard (1939): (50° to 275°)

PROPANE C_3H_8

Prepared in the pure state by using butyronitrile and sodium (Timmermans, 1920). This gas is also obtained by fractionation of mixtures of natural gaseous hydrocarbons (Francis and Robbins, 1933). Survey of the thermodynamic properties: Sage (1934–36) (the properties of this gas are not yet well determined).

Constants

Critical constants: Survey by Pickering (1924)

t° cr	p cr. atm.	
96.81	42.01	Beattie, Hadlock and Poffenberger (1935)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−107.020	11.61	−78.079	111.03	−52.951	458.13	Kemp and Egan (1938)
− 99.890	22.00	−70.300	179.92	−48.112	578.89	„
− 93.368	37.39	−63.284	268.33	−44.404	686.19	„
− 85.863	65.44	−58.228	351.66	−41.748	772.71	„

Boiling point

−42°12	Kemp and Egan (1938)	−42°2	Grosse (1937)
−42°17	Hicks-Bruun and Bruun (1936)	−42°3	Francis and Robbins (1933)

Freezing point

−187°1	Hicks-Bruun and Bruun (1936)	−187°71	Kemp and Egan (1938)

Weight of the normal litre in the gaseous state

0°	2.02000 g	Timmermans (1920)
25°	1.8324 g	Kemp and Egan (1938)

Molecular Weight: 44.096 Casado, Massie and Whytlaw-Gray (1949).

Isotherms: Burgoyne (1940) (−30° to 20°; until 60 atm.)
Reamer, Sage and Lacey (1949) (38° to 238°; until 700 atm).

Specific heat: Kemp and Egan (1938) (M. W. 44.092)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −256.80	0.01963	−214.00	0.2117	−158.05	0.4652	−87.31	0.4970
−253.56	0.03413	−208.29	0.2288	−150.24	0.4673	−82.93	0.5031
−250.05	0.05122	−202.20	0.2467	−144.31	0.4693	−72.27	0.5088
−246.59	0.06740	−196.11	0.2653	−137.26	0.4730	−66.12	0.5111
−242.65	0.08769	−191.84	0.2771	−130.42	0.4741	−60.11	0.5174
−238.58	0.1105			−123.47	0.4780	−53.96	0.5220
−234.31	0.1329	L. −183.49	0.4584	−116.36	0.4809	−48.25	0.5286
−229.48	0.1516	−177.68	0.4596	−108.82	0.4845	−43.40	0.5329
−224.25	0.1723	−171.25	0.4614	−101.19	0.4873		
−218.68	0.1922	−176.71	0.4632	− 94.12	0.4920		

Heat of vaporisation	(B.P.) 101.8 cal 15°/g	Kemp and Egan (1938)
Heat of melting	19.11 ,,	,,

n-BUTANE $n\text{-}C_4H_{10}$

The pure gas is prepared by the method of **Frankland** and **Kolbe** (1848) or by the method of **Lebeau** (1905).

Seibert and **Burrell** (1915) succeeded in purifying, by fractional distillation at reduced pressure, the gas which had been prepared by action of zinc-copper couple on *n*-butyl iodide.

Constants

Critical constants: Survey by **Pickering** (1924)

t° cr.	p cr. atm.	
153.2	35.67	**Seibert** and **Burrell** (1915)

Saturated vapour pressure

t°	p mm	t°	p mm	
−78.043	9.90	−10.883	503.34	**Aston** and **Messerly** (1940)
−60.482	36.26	− 6.361	604.97	„
−46.874	85.59	− 2.753	697.13	„
−37.328	145.58	− 1.123	742.20	„
−26.639	249.53	0.344	764.50	„
−16.846	338.77			„
−67.7	23.5	−17.7	384.5	**Wackher**, **Linn** and **Grosse** (1945)
−60.0	42.5	−11.3	498.0	„
−45.0	99.6	− 7.1	589.3	„
−31.3	207.4	0.0	775.4	„
−22.7	310.9	5.6	955.0	„
40	3350	100	12500	**Seibert** and **Burrell** (1915)
50	4300	110	14700	„
60	5400	120	18100	„
70	6700	130	20600	„
90	10700			„

Boiling point	−0°50	**Aston** and **Messerly** (1940)
	−0°5	**Grosse** (1937)
Melting point	−138°29	**Aston** and **Messerly** (1940)
Transition point	−165°60	„

Weight of the litre in the gaseous state: 2.5185 g /710 mm Beckers (1930)
Corrects the value given by Beckers (1927): 2.5192 g /710 mm
Deviation from Avogadro's law: (between 710 and 0 mm): 0.037039 Beckers (1930)

Specific heat

t°	c_p	t°	c_p	
C. I −258.11	0.0136	C. II −159.39	0.3427	Aston and Messerly (1940)
−254.72	0.02600	−154.36	0.3463	„ (M. W.: 58.121)
−250.80	0.04227	−146.38	0.3521	„
−246.45	0.05887	−142.99	0.3568	„
−241.63	0.08134	L. −133.28	0.4657	„
−236.27	0.1007	−130.96	0.4665	„
−231.13	0.1200	−123.66	0·4717	„
−224.29	0.1449	−110.87	0.4767	„
−218.57	0.1619	−104.67	0.4805	„
−213.54	0.1767	− 87.53	0.4855	„
−212.44	0.1791	− 76.33	0.4905	„
−207.81	0.1933	− 69.92	0.4939	„
−206.89	0.1946	− 57.22	0.5008	„
−200.86	0.2083	− 50.45	0.5039	„
−198.19	0.2135	− 42.35	0.5096	„
−193.84	0.2264	− 34.73	0.5134	„
−187.40	0.2417	− 26.15	0.5223	„
−180.88	0.2568	− 21.73	0.5315	„
−174.99	0.2704	− 11.12	0.5384	„
−169.61	0.2819	− 5.02	0.5413	„

Heat of vaporisation	(B.P.) 92.13 cal 15°/g	Aston and Messerly (1940)
Heat of melting	19.176 cal 15°/g	„
	17.98 cal 15°/g	Huffman, Parks and Barmore (1931)
Heat of transition	8.506 cal 15°/g	Aston and Messerly (1940)
	8.7 cal 15°/g	Huffman, Parks and Barmore (1931)

Iso-BUTANE or 2-METHYLPROPANE $(CH_3)_2CH-CH_3$

Same remarks as for *n*-butane: the work of Hückel and Rassmann (1932) shows how difficult it is to prepare absolutely pure *iso*-butane.

Constants

Critical constants: Survey by Pickering (1924)

t° cr.	p cr. atm.	d cr.	
133.7	36.54	—	Seibert and Burrell (1915)
133.8	—	—	Harand (1935)
134.98	36.00	0.221	Beattie, Edwards and Marple Jr. (1949)

Saturated vapour pressure

t°	p mm	t°	p mm	
−85.090	11.37	−22.071	498.08	Aston, Kennedy and Schumann (1940)
−71.704	31.96	−18.761	572.67	„
−56.431	86.85	−13.238	716.13	„
−44.107	174.26	−11.609	763.44	„
−27.576	391.02			„
−66.7	48.3	−22.7	491.2	Wackher, Linn and Grosse (1945)
−58.0	83.8	−15.0	666.7	„
−44.4	178.9	−11.9	758.0	„
−35.8	271.3	−10.4	799.1	„
−31.0	342.0			„
t°	p atm.	t°	p atm.	
30	3.941	100	19.573	Beattie, Edwards and Marple Jr. (1949)
50	6.701	125	30.440	„
75	11.932			„

Boiling point	−11°7	Wackher, Linn and Grosse (1945)
	−11°72	Aston, Kennedy and Schumann (1940)
Melting point	−159°42	Aston, Kennedy and Schumann (1940)

Isotherms in the critical region: Beattie, Edwards and Marple Jr. (1949)

Orthobaric liquid density

t°	d	t°	d	
30	0.549	100	0.428	Beattie, Edwards and Marple Jr. (1949)
50	0.518	125	0.353	„
75	0.480			„

Specific heat: ASTON, KENNEDY and SCHUMANN (1940) (M. W.: 58.121)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −260.63	0.0114	−207.43	0.19124	L. −156.22	0.4108	−77.06	0.4683
−258.59	0.0197	−204.74	0.19689	−150.05	0.4151	−71.64	0.4729
−256.00	0.0314	−198.59	0.21233	−143.73	0.4168	−66.60	0.4754
−252.62	0.0455	−190.94	0.22897	−137.36	0.4217	−61.53	0.4793
−248.96	0.0615	−188.85	0.23323	−130.32	0.4260	−56.38	0.4874
−244.71	0.0802	−186.69	0.23676	−123.03	0.4313	−50.89	0.4898
237.42	0.1066	−181.96	0.24741	−114.70	0.4383	−45.85	0.4965
−232.65	0.1243	−180.47	0.24985	−107.94	0.4451	−40.27	0.5025
−226.71	0.1427	−175.65	0.2629	−104.46	0.4463	−34.59	0.5104
−222.26	0.1556	−169.55	0.2770	−98.71	0.4506	−28.12	0.5175
−217.48	0.1683	−165.66	0.2835	−92.85	0.4569	−21.22	0.5247
−213.04	0.17855	−162.59	0.2882	−87.29	0.4611	−16.14	0.5275
−210.37	0.18509	−160.58	0.3011	−82.17	0.4651		

Heat of vaporisation	(B. P.) 87.634 cal 15°/g	ASTON, KENNEDY and SCHUMANN (1940)
Heat of melting	18.689 cal 15°/g	,,

PARAFFINS from C_5 to C_8

The series of normal paraffins, from C_5 to C_{12}, has been the subject of a work by SHEPARD, HENNE and MIDGLEY (1931). The same substances, except pentane, were studied by BRUYLANTS (unpublished data). B. E. has given data for some of them.

For all those hydrocarbons, the criteria of purity, besides the constancy of the boiling point, are:

a) the constancy of the freezing point.
b) the constancy of the pressure of isothermal liquefaction.
c) the value of the critical constants of vaporization.
d) the constancy of the critical solution point in nitrobenzene and aniline for successive fractions.
e) the constancy of the density of successive fractions.

n-PENTANE n-C_5H_{12}

Preparation of pure pentane

Many data, attributed to *n*-pentane, refer to *iso*pentane; the old values concerning this substance are unreliable.

n-Pentane is prepared by two different methods, used for the first time by Young (1899), Young and Thomas (1897) and Young (1910).

a) Extraction from petroleum ether by mixed sulphuric and nitric acids, followed by fractional distillation over a very small range.
Shepard, Henne and Midgley (1931); Parks and Huffman (1930).
b) Synthesis: from the normal amyl alcohols through the corresponding iodide or bromide (Mair, 1932) or by catalytic hydrogenation of the corresponding amylenes.

The physical constants of these different samples are very concordant.

Shepard's sample has been used by Dornte and Smyth (1930), but the values of the refractive index given by these authors differ from those of Shepard; for densities, if these authors agree between 0° and 30°, they do not with Young for high temperatures and with Timmermans for temperatures below 0°.

Constants B. E. (1935). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
197.2	25100	0.2323	Young (1910)
—	—	0.23220	Timmermans (1920)

Densities of the liquid and the saturated vapour: Young (1900—10)

t°	L.	V.	t°	L.	V.
30	0.6165	0.002451	170	0.4162	0.0735
40	0.6062	0.003361	180	0.3867	0.0935
50	0.5957	0.004545	186	0.3643	0.1109
60	0.5850	0.006020	190	0.3445	0.1269
70	0.5739	0.007862	193	0.3253	0.1440
80	0.5624	0.01012	195	0.3065	0.1609
90	0.5503	0.01289	196	0.2915	0.1746
100	0.5377	0.01626	196.5	0.2809	0.1841
110	0.5248	0.02024	196.8	0.2730	0.1925
120	0.5107	0.0250	196.9	0.2691	0.1960
130	0.4957	0.0310	197.0	0.2640	0.2005
140	0.4787	0.0386	197.1	0.2560	0.2090
150	0.4604	0.0476	197.15	0.2472	0.2168
160	0.4394	0.0591	197.2	0.2323	0.2323

Rectilinear diameter

(t°cr. → 0°): 0.3232 – 0.0004610 t° Young (1900—10)

(t°cr. → M. P.) 0.44402 – 0.00043413 T° – 0.00000003477 $T^{\circ 2}$ Timmermans (1912) (recalc. by Young).

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
–65.178	3.08	– 9.793	115.07	14.653	344.63	Messerly and Kennedy
–47.811	12.03	– 2.359	164.51	18.613	403.33	„ (1940)
–39.537	21.14	+ 3.618	215.77	21.679	454.08	„
–27.420	44.64	9.621	279.80	24.828	511.64	„
–17.476	77.56					„
–30	37.95	90	3498	193	23540	Young (1910)
–20	67.85	100	4410	195	24225	„
–10	114.30	110	5483	196	24665	„
0	183.25	120	6742	196.5	24850	„
10	281.8	130	8187	196.8	24960	„
20	420.2	140	9892	196.9	24995	„
30	610.9	150	11805	197.0	25020	„
40	873	160	14060	197.1	25060	„
50	1193	170	16540	197.15	25090	„
60	1605	180	19345	197.2	25100	„
70	2119	186	21190			„
80	2735	190	22500			„

Boiling point

36°0	Cummings, Stones and Volante (1933)	36°075	Howards, Mears, Fookson, Pomerantz and Brooks (1947)
36°0	Shepard, Henne and Midgley (1931)	36°077	Wojciechowski (1936)
		36°10	B. E. (1935)
36°05	Messerly and Kennedy (1940)	36°15	Young (1897—1900)
36°05	Hubbard and Brown (1943)	36°15	Lecat
36°06	Mair (1932)		

$\frac{dt}{dp}$ *(10 mm)*

0°388	Howards, Mears, Fookson, Pomerantz and Brooks (1947)	0°41	B. E. (1935)
0°39	Young (1897—1900)	0°42	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)
0°391	Wojciechowski (1936)		

Freezing point

−129°69	Messerly and Kennedy (1940)	−129°748	Mair (1932)
−129°7	Wibaut, Hoog, etc (1939)	−129°75	Howard, Mears, etc. (1947)
−129°7	Parks and Huffman (1930)	−129°753	Glasgow, Murphy, Willingham and Rossini (1946)

N.B. The value by B. E. (1935) −129°1 is too high owing to an inaccuracy in the thermometric scale in that region.

Critical solution point

in $C_6H_5NO_2$	24°5	B. E. (1935)
in $C_6H_5NH_2$	71°4	Shepard, Henne and Midgley (1931)
	71°7	Wibaut, Hoog, etc. (1939)

Gaseous state

Isotherms: Young (1910) — (in the critical region): Sage and Lacey (1942).

Liquid state

Density

t°	d	t°	d	t°	d	
−136.5	0.76827	−74.25	0.71249	−30.6	0.67391	Timmermans (1912)
−123.3	0.75531	−63.3	0.70298	−22.9	0.66682	„
−116.2	0.74930	−53.6	0.69483	−13.1	0.65766	„
−111.6	0.74541	−45.0	0.68724	− 6.2	0.65120	„
−104.85	0.73952	−37.2	0.67981	0.0	0.64537	„
− 94.5	0.73085	−35.3	0.67847	15.0	0.63106	„
− 83.4	0.72097					„

t°	d		t°	d	
0	0.64539	Young (1897—1900)	0	0.64543	B. E. (1935)
10	0.6360	„	15	0.63114	„
20	0.6263	„	30	0.61607	„
30	0.6165	„			
10	0.6359	Dornte and Smyth (1930)	20	0.62619	Howard, Mears, etc. (1947)
20	0.6263	„	20	0.62632	Shepard, Henne and Midgley (1931)
30	0.6163	„			
15	0.63109	Wibaut, Hoog, etc. (1939)	25	0.6213	Hubbard and Brown (1943)
30	0.62624	„	25	0.62133	Howard, Mears, etc. (1947)

Viscosity

t°	$\eta . 10^5$		t°	$\eta . 10^5$	
15	241	B. E. (1935)	25	229.6	Hubbard and Brown (1943)
30	205	„	50	187.9	„
20	227	Geist and Cannon (1946)	25	216.6	Shepard, Henne and Midgley (1931)

Surface tension

t°	γ		t°	γ	
15	16.63	B. E. (1935)	20	15.98	Wibaut, Hoog, etc. (1939)
20	16.00	„			
30	15.00	„			

Refractive index

t°	He r.	Hα	D	He y.	He g.	H β	He v.	H γ	
15	1.35822	1.35862	1.36033	1.36051	1.36401	1.36495	1.36763	—	B. E. (1935)
$\frac{dn}{dt}$	0.00055	55	—	55	56	56	58	—	„
15	—	1.35866	1.36058	—	—	1.36490	—	1.36849	Wibaut, Hoog, etc.
20	—	1.35587	1.35769	—	—	1.36200	—	1.36561	„ (1939)
$\frac{dn}{dt}$	—	0.00056	58	—	--	58	—	58	„
20	—	1.35581	1.35769	—	—	1.36208	—	—	Shepard, Henne, etc.
25	—	1.35309	1.35495	—	—	1.35930	—	—	„ (1931)
$\frac{dn}{dt}$	—	0.00054	55	—	—	56	—	—	„
20	—	—	1.35746	—	—	—	—	—	Howard, Mears, etc.
25	—	—	1.35480	—	—	—	—	—	„ (1947)
$\frac{dn}{dt}$	—	—	0.00053	—	—	—	—	—	„
20	—	—	1.3577	—	—	—	—	—	Woodburn, Smith and Tetewsky (1944)
25	—	—	1.35470	—	—	—	—	—	Mair (1932)

Heat constants

Specific heat

t°	c_p	t°	c_p	
C. −260.75	0.01039	−137.12	0.2993	Messerly and Kennedy (1940) (M.W. 72.146)
−258.45	0.01621	−135.54	0.3099	„
−254.64	0.02900	−133.58	0.3169	„
−250.37	0.04446	L. −121.84	0.4663	„
−245.61	0.06041	−116.19	0.4673	„
−240.30	0.08128	−110.39	0.4690	„
−235.16	0.09712	−104.78	0.4692	„
−230.26	0.1112	− 98.96	0.4701	„
−224.49	0.1290	− 93.09	0.4709	„
−219.12	0.14431	− 87.45	0.4731	„
−214.17	0.16078	− 82.63	0.4749	„
−208.19	0.1745	− 76.49	0.4759	„
−205.14	0.18286	− 66.11	0.4815	„
−199.07	0.19647	− 57.32	0.4849	„
−191.94	0.21073	− 47.00	0.4898	„
−185.39	0.2239	− 38.35	0.4980	„
−179.59	0.2352	− 28.61	0.5068	„
−173.67	0.2444	− 18.94	0.5132	„
−167.39	0.2554	− 10.60	0.5224	„
−160.42	0.2667	− 3.15	0.5274	„
−154.03	0.2756	+ 5.92	0.5446	„
−147.52	0.2855	+ 13.25	0.5527	„
−141.33	0.2945			„
C. −180.36	0.233	−103.26	0.468	Parks and Huffman (1930)
−175.56	0.243	− 87.66	0.473	„
−170.46	0.251	− 72.76	0.479	„
−164.56	0.261	− 58.26	0.485	„
−158.36	0.271	− 41.96	0.494	„
−152.16	0.282	− 12.96	0.514	„
−146.46	0.292	+ 1.64	0.528	„
−140.96	0.306	6.04	0.531	„
L. −123.26	0.465	11.54	0.536	„
−119.06	0.465	16.84	0.540	„
−110.76	0.468			„

Heat of vaporisation	(B.P.) 85.38 cal 15°/g	Pitzer (1941)
	„ 86.86 cal 15°/g	Messerly and Kennedy (1940)
Heat of melting	27.75 cal 15°/g	Parks and Huffman (1930)
	27.894 cal 15°/g	Messerly and Kennedy (1940)
Heat of combustion	25° (c_p) 11625.1 cal 15°/g	Prosen and Rossini (1944) (M.W. 72.146)

Iso-PENTANE $(CH_3)_2CH-CH_2-CH_3$

Preparation in a state of purity

According to YOUNG (1895—1899), YOUNG and THOMAS (1897) and YOUNG (1910), pure *iso*pentane may be obtained:

1. by fractionation of petroleum ether until constancy of the properties. The samples of *iso*pentane used by many authors were derived from petroleum ether, but as the fractionation was generally not carried out until a perfectly definite product was obtained, almost all results recorded in the literature on this subject must be accepted with caution.
2. by dehydration of *iso*amyl alcohol into the corresponding amylene and catalytic hydrogenation of the latter.
3. by reduction of *iso*amyl iodide.

PARKS' sample is possibly less pure than ours, since it is a KAHLBAUM product submitted to fractional distillation, but without any preliminary chemical treatment; while EYKMAN's sample is a KAHLBAUM product, distilled over sodium but not fractionated.

Constants: B. E. (1926). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d. cr.	
187.8	25020	0.2343	YOUNG (1900)
—	—	0.23444	TIMMERMANS (1920)

Densities of the liquid and the saturated vapour: YOUNG (1910)

t°	L.	V.	t°	L.	V.
0	0.63930	0.0011	130	0.4826	0.03831
10	0.6295	0.001650	140	0.4642	0.04728
20	0.6196	0.002344	150	0.4445	0.05834
30	0.6092	0.003266	160	0.4206	0.07289
40	0.5988	0.004456	170	0.3914	0.09337
50	0.5881	0.005956	176	0.3694	0.1101
60	0.5769	0.007836	180	0.3498	0.1258
70	0.5656	0.01013	183	0.3311	0.1418
80	0.5540	0.01287	185	0.3142	0.1574
90	0.5413	0.01621	186	0.3028	0.1676
100	0.5278	0.02020	187	0.2857	0.1833
110	0.5140	0.02513	187.4	0.2761	0.1951
120	0.4991	0.03106	187.8	0.2343	0.2343

Rectilinear diameter

(between t° cr. and 0°) $0.3202 - 0.0004658\, t^{\circ} + 0.0000000463\, t^{\circ 2}$ **Young** (1900 – 1910)
(between t° cr. and freezing point) $0.44806 - 0.00047586\, T^{\circ} + 0.00000002664\, T^{\circ 2}$ **Timmermans** (1912) (recalc. by Young)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−55.854	10.95	−17.399	114.89	8.471	369.37	**Schumann, Aston** and **Sagenkahn** (1942)
−41.739	29.08	− 9.556	168.56	13.827	456.51	
−34.349	45.67	− 2.663	231.49	19.048	556.43	„
−27.828	66.28	+ 3.780	304.43	22.036	620.98	„
−22.766	87.14					„
−30	58.55	70	2556.7	170	19115	**Young** (1910)
−20	100	80	3383.0	176	20970	„
−10	164.15	90	4281.3	180	22270	„
0	257.35	100	5345.5	183	23310	„
10	390.4	110	6583.8	185	24000	„
20	572.2	120	8018.0	186	24370	„
30	819.0	130	9684.0	187	24730	„
40	1140.5	140	11634	187.4	24880	„
50	1535.7	150	13802	187.8	25018	„
60	2036.5	160	16320			„

t°	p mm	
0.32	260.6	**Roland** (1928)
17	505	**Hirshberg** (1932)

Boiling point

27°78	**Schumann, Aston** and **Sagenkahn** (1942)	27°92	**Guthrie Jr.** and **Huffman** (1943)
27°80	**Wibaut, Hoog, Langedyk, Overhoff** and **Smittenberg** (1939)	27°95	**Young** (1910)
27°853	**Howard, Mears, Fookson, Pomerantz** and **Brooks** (1947)	27°95	B. E. (1926) and **Lecat** (passim)
		28°0	**Parks, Huffman** and **Thomas** (1930)

$\frac{dt}{dp}$ (10 mm)

0°37	B. E. (1926)	0°386	**Howard, Mears**, etc. (1947)
0°38	**Young** (1902—10)	0°40	**Wibaut, Hoog**, etc. (1939)

Freezing point

−159°77	Schumann, Aston and Sagenkahn (1942)	−159°922	Glasgow, Murphy, Willingham and Rossini (1946)
−159°79	Guthrie Jr. and Huffman (1943)	−160°0	Timmermans, Van der Horst and Kamerlingh Onnes (1922)
−159°9	Howard, Mears, etc. (1947)	−160°04	Knowlton and Rossini (1939)

Critical solution point

in $C_6H_5NO_2$	32°1	B. E. (1926)
in $C_6H_5NH_2$	78°9	Wibaut, Hoog, etc. (1939)

Isotherms: Young (1910)

Constants of state

Density

t°	d	t°	d	t°	d	
−158.05	0.78714	−83.4	0.71719	−30.6	0.66880	Timmermans (1912)
−136.5	0.76661	−74.25	0.70884	−22.95	0.66140	„
−123.3	0.75323	−63.3	0.69891	−13.1	0.65192	„
−116.2	0.74691	−53.6	0.69035	− 6.2	0.64588	„
−111.6	0.74281	−45.0	0.68238	0	0.63943	„
−104.85	0.73672	−37.2	0.67493	15	0.62463	„
−94.5	0.72760	−35.3	0.67335			

t°	d		t°	d	
0	0.63945	B. E. (1926)	15	0.62473	Wibaut, Hoog,
15	0.62470	„	20	0.61972	„ etc. (1939)
0	0.63930	Young (1910)	20	0.61963	Howard, Mears,
15	0.6245	„	25	0.61455	„ etc. (1947)
15.2	0.6257	Eykman (1906)			
19.1	0.6206	„			

Viscosity

t°	$\eta \cdot 10^5$	
0	274	B. E. (1926)
15	234	„

Surface tension

t°	γ	
10	16.10	Hennaut-Roland and Lek (1931)
15	15.54	,,
20	15.00	,,
20	14.97	Wibaut, Hoog, etc. (1939)

Refractive index

t°	He r.	H α	D	He y.	He g.	H β	He bl.	He v.	H γ	
14.2	1.35552	1.35578	—	1.35761	1.36111	1.36195	1.36285	1.36450	1.36552	Eykman (1906)
15	1.35472	1.35505	1.35691	1.35700	1.36052	1.36147	—	1.36413	—	B. E.*
$\frac{dn}{dt}$	0.00055	55	—	55	55	57	—	58	—	,,
15	—	1.35509	1.35691	—	—	1.36125	—	—	1.36487	Wibaut,, Hoog, etc. (1939)
20	—	1.35218	1.35396	—	—	1.35827	—	—	1.36182	,,
$\frac{dn}{dt}$	—	0.00058	59	—	—	60	—	—	—	,,
20	—	—	1.35357	—	—	—	—	—	—	Howard, Mears, etc. (1947)
25	—	—	1.35067	—	—	—	—	—	—	,,
$\frac{dn}{dt}$	—	—	0.00058	—	—	—	—	—	—	,,

* These values correct the values of B.E. (1926)

Heat constants

Specific heat

t°	c_p	t°	c_p	
C. −259.96	0.01551	−210.57	0.1790	Guthrie Jr. and Huffman (1943)
−256.74	0.02711	−206.85	0.1908	,, (M. W. 72.146)
−253.96	0.03811	−203.92	0.2015	,,
−250.26	0.05350	−197.15	0.2049	,,
−246.22	0.06976	−194.21	0.2098	,,
−241.24	0.08875	−190.66	0.2177	,,
−235.51	0.1084	−186.69	0.2269	,,
−229.75	0.1257	−182.64	0.2367	,,
−223.96	0.1419	−177.72	0.2486	,,
−218.37	0.1566	−171.74	0.2647	,,
−214.57	0.1672	−165.48	0.2843	,,

Specific heat (continued)

t°	c_p	t°	c_p	
L. −157.49	0.4086	−52.56	0.4715	Guthrie Jr. and Huffman (1943)
−150.29	0.4125	−43.16	0.4795	(M. W. 72.146)
−139.22	0.4185	−33.90	0.4866	,,
−123.90	0.4267	−24.79	0.4945	,,
−113.36	0.4322	−15.82	0.5029	,,
−103.00	0.4383	−5.26	0.5138	,,
−92.81	0.4442	−1.28	0.5180	,,
−82.78	0.4505	+7.19	0.5266	,,
−72.91	0.4570	15.60	0.5352	,,
−62.11	0.4644	24.65	0.5448	,,
C. −233.16	0.100	−133.16	0.4214	Schumann, Aston and Sagenkahn
−228.16	0.117	−123.16	0.4261	,, (1942) (M. W. 72.146)
−223.16	0.131	−113.16	0.4308	,,
−218.16	0.1444	−103.16	0.4366	,,
−213.16	0.1577	−87.16	0.4432	,,
−203.16	0.1717	−33.16	0.4882	,,
−193.16	0.2081	−23.16	0.4978	,,
−183.16	0.2352	−13.16	0.5075	,,
−173.16	0.2609	− 3.16	0.5183	,,
−163.16	0.2878	+ 6.84	0.5314	,,
L. −153.16	0.4117	16.84	0.5616	,,
−143.16	0.4160			,,

Heat of vaporisation	25°	81.533 cal 15°/g	Schumann, Aston and Sagenkahn (1942)
Heat of melting		16.94 cal 15°/g	Parks, Huffman and Thomas (1930)
		17.010 cal 15°/g	Schumann, Aston and Sagenkahn (1942)
		17.050 cal 15°/g	Guthrie Jr. and Huffman (1943)
Heat of combustion	25° (c_p)	11689.8 cal 15°/g	Knowlton and Rossini (1939) (M. W. 72.146)

TETRAMETHYLMETHANE OR 2,2-DIMETHYL *n*-PROPANE $C(CH_3)_4$

Prepared by the action of zinc-methyl or methylmagnesium bromide on *tertiary* butyl bromide. Whitmore and Fleming (1933).

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−42.0	87.1	−21.7	222.0	−13.4	316.5	Whitmore and Fleming
−38.0	104.6	−19.4	247.0	−8.0	394.0	,, (1933)
−33.1	135.1	−17.6	269.8	−1.0	523.7	,,
−30.5	155.6	−17.2	276.0	+3.1	605.7	,,
−28.1	172.1	−15.8	286.9	9.4	760.0	,,
−24.0	206.1					,,

Boiling point	9°4	Whitmore and Fleming (1933)
	9°503	Howard, Mears, Fookson, Pomerantz and Brooks (1947)
	9°6	De Darwent and Steacie (1948)
Freezing point	−16°550	Streiff, Zimmermans, Soule, Butt, Sedlak, Willingham and Rossini (1948)
	−16°60	Howard, Mears, etc. (1947)

Refractive index	t°	0°	2°	4°	6°
	n_D	1.3513	1.3498	1.3486	1.3476

Heat of combustion	25° (c_p) 11651.5 cal 15°/g	Knowlton and Rossini (1939) (M. W. 72.146)

n-HEXANE n-C_6H_{14}

Preparation in a state of purity

1. from petroleum ether, by destruction of methylpentamethylene by means of hot fuming nitric acid, followed by fractional distillation.
2. by the action of sodium on *n*-propyl iodide; it is difficult to eliminate the last traces of the halogenated compound by treatment with concentrated sulphuric acid, and by boiling over sodium.
3. by dehydration of hexyl alcohol into hexene-2, and catalytic hydrogenation of the latter.

Chief papers: Thomas and Young (1895); Young (1898—1910); Faillebin (1924); Shepard, Henne and Midgley (1931) and Mair (1932)

Constants: B. E. (1928)

P. Bruylants, of the University of Louvain, has kindly communicated the unpublished results of his measurements on this compound.

Polyphasic equilibria

Critical constants

t° cr.	p cr. mm	d cr.	
234.7	22754	0.233	Kay (1946)
234.8	22510	0.2344	Young (1910)
234.8	22800	—	Kelso and Felsing (1942)

Densities of the liquid and the saturated vapour Young (1910)

t°	L.	V.	t°	L.	V.
0	0.6769	0.0002	140	0.5343	0.01866
10	0.6683	0.0004	150	0.5207	0.02299
20	0.6595	0.0006	160	0.5063	0.02833
30	0.6505	0.0009	170	0.4913	0.03472
40	0.6412	0.0013	180	0.4751	0.04228
50	0.6318	0.0018	190	0.4570	0.05155
60	0.6221	0.002488	200	0.4365	0.06329
70	0.6122	0.003367	210	0.4124	0.07899
80	0.6022	0.00446	220	0.3810	0.1011
90	0.5918	0.00585	226	0.3557	0.1203
100	0.5814	0.00754	230	0.3329	0.1405
110	0.5703	0.00956	233	0.3040	0.1658
120	0.5588	0.01202	234	0.2883	0.1807
130	0.5467	0.01504	234.8	0.2344	0.2344

Rectilinear diameter: 0.3388—0.0004445 t° (between t°cr. and 0°) Young (1900—10)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
—99.0	0.009	−76.2	0.119	−56.1	0.916	−33.6	5.33	Drücker, Jimeno and Kangro (1915)
—98.4	0.010	−64.4	0.397	−51.5	1.29	−21.6	12.55	
—83.0	0.050	−57.8	0.750	−50.9	1.395	−10.7	25.04	
—80.6	0.067	−57.3	0.796	−43.9	2.44	− 2.8	39.15	,,
−66.4	0.327	−62.3	0.482	−56.3	0.880	−47.4	1.913	Mündel (1913)
−64.7	0.396	−58.8	0.687	−49.6	1.606	−46.9	2.002	,,
−30	6.95	50	400.9	130	3719	210	15577	Young (1910)
−20	14.10	60	566.2	140	4606	220	18100	,,
−10	25.90	70	787.0	150	5610	226	19765	,,
0	45.45	80	1062	160	6793	230	20955	,,
10	75.00	90	1407	170	8123	233	21890	,,
20	120.0	100	1836	180	9651	234	22220	,,
30	185.4	110	2358	190	11380	234.8	22510	,,
40	276.7	120	2982	200	13349			,,
0	45.43	21.82	131.1	44.48	328.4	67.07	717.0	Schmidt (1934)
9.50	73.6	27.40	166.7	52.79	444.3	70.56	800.2	,,
16.42	102.3	37.78	255.1	59.41	558.1	77.48	985.2	,,
21.67	130.4							
13.033	87.74	28.528	175.90	49.803	402.45	68.067	744.09	Willingham, Taylor, Pignocco and Rossini (1945)
16.576	103.65	33.631	217.19	56.030	500.72	68.540	755.27	
20.618	124.66	38.311	261.74	62.785	627.95	69.081	768.02	
24.717	149.41	43.967	324.94	67.554	732.10	69.541	779.41	

Boiling point

68°6	Tongberg and Johnston (1933)	68°740	Forziati, Glasgow Jr., Willingham and Rossini (1946)
68°68	Stull (1937)	68°75	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)
68°70	Mair (1932)	68°76	Cramer and Milligan (1936)
68°70	Lemons and Felsing (1943)	68°80	B. E. (1928)
68°7	Kay (1946)	68°8	Lecat (passim)
68°71	Shepard, Henne and Midgley (1931)	68°92	Schmidt (1934)
68°733	Wojciechowski (1936)	68°95	Young (1900)
68°739	Willingham, Taylor, Pignocco and Rossini (1945)	68°95	Thiry (1925)

$\frac{dt}{dp}$ *(10 mm)*

0°417	Schmidt (1934)	0°42	Young (1902)
0°419	Wojciechowski (1939)	0°42	Shepard, Henne and Midgley (1931)
0°4191	Forziati, Glasgow Jr., Willingham and Rossini (1946)	0°42	Willingham, Taylor, Pignocco and Rossini (1945)
0°420	Wojciechowski (1936)		
0°42	B. E. (1928) and Lecat (passim)		

Freezing point

−95°1	B. E. (1928)	−95°338	Forziati, Glasgow Jr., etc. (1946)
−95°2	Huffman, Parks and Barmore (1931) (corr. Huffman, Parks and Thomas, 1930)	−95°355	Mair (1932)
−95°2	Stull (1937)	−95°39	Shepard, Henne and Midgley (1931)
−95°320	Glasgow Jr., Murphy, Willingham and Rossini (1946)	−95°5	Wibaut, Hoog, etc. (1939)

Triple point: −95°32 Douslin and Huffman (1946)

Critical solution point

in $C_6H_5NO_2$	20°60	B. E. (1928)
	21°0	Timmermans (1910)
in $C_6H_5NH_2$	68°9	Timmermans (1911)
	69°0	Shepard, Henne and Midgley (1931)
	69°1	Wibaut, Hoog, etc. (1939)
	69°2	Thiry (1925)

Isotherms: Young (1910) and Kelso and Felsing (1942)

Constants of state

Density

t°	d		t°	d	
			20	0.65937	Forziati, Glasgow Jr., etc. (1946)
0	0.67696	Young (1900)			
15	0.6639	„	25	0.65481	„
0	0.67704	B. E. (1928)	20	0.65943	Wibaut, Hoog, etc. (1939)
15	0.66380	„	25	0.65490	„
30	0.65055	„	20	0.6593	Quayle, Day and Brown
0	0.67706	Bruylants (unp.)	30	0.6502	„ (1944)
15	0.66388	„	40	0.6406	„
30	0.65054	„	20	0.6593	Tongberg and Johnston (1933)
20	0.65945	Shepard, Henne and Midgley (1931)	20	0.6594	Lemons and Felsing (1943)
25	0.65502	„	20	0.6595	Cramer and Milligan (1936)
			20	0.6595	Vogel (1946)
			30	0.6507	Dornte and Smyth (1930)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	337	B. E. (1928)	16.35	328	Drapier (1911)
30	278	„	18.55	320	„
25	293.7	Shepard, Henne and Midgley (1931)	20	318	„
			21.40	313	„
			23.22	310	„

Surface tension

t°	γ		t°	γ	
15	18.94	Lek (1930) and Hennaut-Roland and Lek (1931)	30	17.37	Quayle, Day and Brown (1944)
20	18.42		40	16.35	„
30	17.40	„	0	20.52	Harkins and Cheng 1921)
20	18.41	Wibaut, Hoog, etc. (1939)	20	18.43	„

Refractive index

t°	He r.	H α	D	He y.	He g.	H β	He v.	H γ	
15	1.37527	1.37560	1.37743	1.37762	1.38122	1.38219	1.38508	—	B. E. corr. B. E. (1928)
$\frac{dn}{dt}$	0.00050	50	50	50	52	52	52	—	,,
15	1.37533	1.37563	1.37745	1.37754	1.38118	1.38210	1.38480	1.38589	Bruylants, (unp.)
30	1.36786	1.36818	1.36997	1.37008	1.37314	1.37447	1.37724	1.37818	,,
$\frac{dn}{dt}$	0.00049	50	50	50	53	51	50	51	,,
20		1.37310	1.37506	—	—	1.37979	—	—	Shepard, Henne and Midgley (1931)
25	—	1.37043	1.37230	—	—	1.37695	—	—	
45.3	—	1.35924	1.36132	—	—	1.36567	—	—	,,
$\frac{dn}{dt}$	—	0.000535	55	—	—	57	—	—	,,
20	—	1.37300	1.37499	—	—	1.37950	—	1.38325	Wibaut, Hoog, etc.
25	—	1.37034	1.37229	—	—	1.37676	—	1.38044	,, (1939)
$\frac{dn}{dt}$	—	0.00053	54	—	—	55	—	56	,,
20	—	—	1.37486	—	—	—	—	—	Forziati, Glasgow Jr., etc. (1946)
25	—	—	1.37226	—	—	—	—	—	
$\frac{dn}{dt}$	—	—	0.00052	—	—	—	—	—	,,
20	—	1.37308	1.37490	—	—	1.37951	—	1.38318	Dornte and Smyth (1930)
20	—	1.37333	1.37518	—	—	1.37974	—	1.38286	Vogel (1946)
20	—	—	1.3750	—	—	—	—	—	Tongberg and Johnston (1933)
20	—	—	—	1.3750	—	—	—	—	Lemons and Felsing (1943)
20	—	—	1.3751	—	—	—	—	—	Woodburne, Smith and Tetewsky (1944)
25	—	—	1.37224	—	—	—	—	—	Mair (1932)

Dielectric constant

t°	ε	t°	ε	
−30	1.972	25	1.8889	Le Fevre (1938)
−15	1.946	35	1.872	,,
0	1.925	45	1.858	,,
15	1.904	55	1.844	,,

Dielectric constant (continued)

t°	ε	
10	1.906	Dornte and Smyth (1930)
30	1.875	„
50	1.844	„

Magnetic rotatory power: Lowry (1913—14) (Young's sample)

Heat constants

Specific heat

t°	c_p	t°	c_p	
C. −179.76	0.219	−109.66	0.328	Huffman, Parks and Barmore (1931)
−174.16	0.227	L. −84.36	0.472	„
−158.16	0.251	−55.36	0.482	„
−141.76	0.274	+ 2.24	0.521	„
−127.76	0.295	3.04	0.523	„
−118.36	0.309	20.34	0.536	„
C. −260.08	0.01093	−130.14	0.29239	Douslin and Huffman (1946) (M. W.
−258.24	0.01514	−121.50	0.30501	„ 86.172)
−255.98	0.02134	−119.73	0.30712	„
−254.92	0.02477	−111.84	0.31999	„
−253.20	0.02987	−111.76	0.32008	„
−249.96	0.04056	−105.66	0.33059	„
−249.68	0.04143	−99.66	0.34591	„
−245.34	0.05607	L. −92.74	0.47170	„
−244.26	0.05973	−82.72	0.47306	„
−240.63	0.07203	−82.13	0.47343	„
−238.44	0.07926	−79.29	0.47394	„
−233.59	0.09471	−73.82	0.47464	„
−228.21	0.11091	−72.39	0.47597	„
−221.86	0.12884	−70.46	0.47665	„
−217.27	0.14058	−64.98	0.47770	„
−214.90	0.14700	−60.83	0.47963	„
−210.60	0.15726	−60.11	0.48066	„
−203.73	0.17245	−50.43	0.48438	„
−196.59	0.18752	−47.97	0.48580	„
−190.03	0.20042	−40.16	0.49029	„
−189.01	0.20245	−35.18	0.49417	„
−182.65	0.21433	−30.03	0.49741	„
−177.69	0.22238	−21.76	0.50286	„
−174.47	0.22749	−20.04	0.50568	„
−166.78	0.23945	−10.19	0.51120	„
−161.16	0.24764	− 8.21	0.51358	„
−158.60	0.25166	− 0.48	0.51961	„
−149.95	0.26425	+ 5.08	0.52432	„
−141.25	0.27659	9.07	0.52816	„
−139.39	0.27903	17.71	0.53546	„
−131.72	0.28969	27.82	0.54474	„

Heat of vaporisation	25°	87.503	cal 15°/g	Osborne and Ginnings (1947)
	25°	85.9	,,	Lemons and Felsing (1943)
	40°	84.5	,,	,,
	60°	80.4	,,	,,
	80°	78.2	,,	,,
Heat of melting		34.26	,,	Stull (1937)
		36.277	,,	Douslin and Huffman (1946)
Heat of combustion	30° (c_p)	11540.3	,,	Jessup (1937) (M. W. 86.1674)
	25° (c_p)	11544.8	,,	,,
	25° (c_p)	11546.5	,,	Prosen and Rossini (1944) (M. W. 86.172)

ISOMERIC HEXANES

All were synthetised in the pure state by Chavanne and his collaborators. Van Risseghem (1921—24); Chavanne and Van Risseghem (1922).

2-METHYLPENTANE $CH_3-CH(CH_3)-CH_2-CH_2-CH_3$

Prepared in the pure state by hydrogenation of 4-methylpentene-2, obtained from methyl*iso*butylcarbinol.

Constants — Polyphasic equilibria

Critical constants

t° cr.	p cr. atm.	
224.9	29.95	Kay (1946)

Saturated vapour pressure: Willingham, Taylor, Pignocco and Rossini (1945).

t°	p mm	t°	p mm	t°	p mm
12.758	124.66	35.810	324.93	59.607	744.07
16.820	149.42	41.567	402.44	60.074	755.26
20.584	175.90	47.714	500.70	60.602	767.99
25.617	217.18	54.388	627.94	61.066	779.37
30.237	261.75	59.099	732.09		

Boiling point

60°13	Kay (1946)	60°267	Wojciechowski (1939)
60°19	Bruun, Hicks-Bruun and Faulconer (1937)	60°27	Stull (1937)
60°2	Van Risseghem (1921)	60°271	Willingham, Taylor, Pignocco and Rossini (1945) and Forziati, Glasgow Jr., Willingham and Rossini (1946)
60°266	Howard, Mears, Fookson, Pomerantz and Brooks (1947)	60°3	Tongberg and Fenske (1933)

$\frac{dt}{dp}$ (10 mm)

0°41	Willingham, Taylor, etc. (1945)	0°414	Wojciechowski (1939)
		0°418	Howard, etc. (1947)

Freezing point

−153°45	Stull (1937)	−153°73	Howard, Mears, Fookson, Pomerantz and Brooks (1947)
−153°680	Glasgow Jr., Murphy, Willingham and Rossini (1946)	−154°0	Bruun, Hicks-Bruun and Faulconer (1937)
−153°700	Forziati, Glasgow Jr., Willingham and Rossini (1946)		
−153°71	Wojciechowski (1939)		

Triple point: −153°61 Douslin and Huffman (1946)

Critical solution point

in $C_6H_5NH_2$	74°5	Thiry (1925)
	74°7	Van Risseghem (1921)

Isotherms: Kelso and Felsing (1942)

Constants of state

Density

t°	d		t°	d	
0	0.6712	Van Risseghem (1938)	0	0.6711	Chavanne and Van Risseghem (1922)
15	0.6580	„	15	0.6583	
20	0 6536	„	15	0.6580	Thiry (1925)
			20	0.6536	Kay (1946)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
0	371	25	295	CHAVANNE and VAN RISSEGHEM (1922)
15	324	30	280	„
20	310			„

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.3725	1.37445	1.3792	1.3829	VAN RISSEGHEM (1924–38)
15	—	1.3745	—	—	TONGBERG and FENSKE (1936)
20	—	1.3722	—	—	„
$\frac{dn}{dt}$	—	0.00046	—	—	„

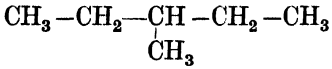
Heat constants

Specific heat: DOUSLIN and HUFFMAN (1946) (M. W. 86.172)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −260.16	0.01309	−220.74	0.13876	L. −169.60	0.40152	−89.36	0.43944
−258.66	0.01657	−217.79	0.14324	−155.75	0.40683	−79.34	0.44536
−257.03	0.02208	−210.54	0.15508	−152.00	0.40828	−69.47	0.45239
−255.26	0.02805	−205.05	0.16693	−149.58	0.40914	−59.76	0.45912
−252.86	0.03592	−198.66	0.17978	−147.54	0.41080	−50.20	0.46633
−249.95	0.04602	−191.46	0.19403	−142.92	0.41194	−40.80	0.47410
−249.46	0.04796	−186.95	0.20264	−140.92	0.41326	−31.54	0.48155
−246.73	0.05710	−184.80	0.20692	−136.35	0.41489	−21.54	0.49115
−244.10	0.06592	−180.58	0.21412	−131.12	0.41760	−10.82	0.50113
−243.10	0.06913	−178.54	0.21767	−127.72	0.41964	− 0.30	0.51104
−239.28	0.08121	−174.55	0.22467	−120.40	0.42217	+10.03	0.52140
−239.27	0.08125	−172.61	0.22789	−117.09	0.42423	20.17	0.53256
−234.74	0.09487	−168.80	0.23415	−109.37	0.42788	30.11	0.54254
−233.00	0.09957	−166.94	0.23714	− 99.53	0.43372		
−228.94	0.11067	−162.62	0.24438	− 91.48	0.43807		
−226.36	0.11737	−161.49	0.24630				
−222.97	0.13153						

Heat of vaporisation	20°	82.7	cal 15°/g	LEMONS and FELSING (1943)
	40°	80.5	„	„
	60°	76.5	„	„
	80°	74.7	„	„
	25°	82.836	„	OSBORNE and GINNINGS (1947)
Heat of melting		17.379	„	DOUSLIN and HUFFMAN (1946)

3-METHYLPENTANE



$CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_3$

Prepared in the pure state by hydrogenation of 3-methylpentene-2 obtained from diethylketone.

Constants

Critical constants

t° cr.	p cr. at.	d cr.	
231.2	30.83	0.235	Kay (1946)

Boiling point

63°18	Cramer and Mulligan (1936)	63°256	Wojciechowski (1939)
63°20	Van Risseghem (1921)	63°26	Stull (1937)
63°20	Bruun, Hicks-Bruun and Faulconer (1937)	63°30	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)

$\frac{dt}{dp}$ (10 *mm*) 0°418 Wojciechowski (1939)

Critical solution point

in $C_6H_5NH_2$	69°3	Wibaut, Hoog, etc. (1939)
	69°4	Van Risseghem (1921)
	69°6	Thiry (1925)

Density

t°	d		t°	d	
0	0.6819	Chavanne and Van Risseghem (1922)	20	0.6642	Cramer and Mulligan (1936)
			20	0.66435	Wibaut, Hoog, etc. (1939)
15	0.6690	„	25	0.65978	„
0	0.6820	Van Risseghem (1938)	20	0.66438	Howard, Mears, Fookson, Pomerantz and Brooks (1947)
15	0.6687	„			
20	0.6642	„			
15	0.6690	Bruun, Hicks-Bruun and Faulconer (1937)	25	0.65972	„
			20	0.6639	Kelso and Felsing (1942)
20	0.6640	„	30	0.6550	„
15	0.6687	Thiry (1925)	40	0.6460	„
20	0.6640	Kay (1946)			

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
0	394	25	307	CHAVANNE and VAN RISSEGHEM (1922)
15	339	30	292	,,

Surface tension

t°	γ		t°	γ	
20	18.10	WIBAUT, HOOG, etc. (1939)	30	17.08	KELSO and FELSING (1942)
20	18.12	KELSO and FELSING (1942)	40	16.03	,,

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.3775	1.3793	1.3841	1.3878	VAN RISSEGHEM (1938)
15	—	1.3790	—	—	BRUUN, HICKS-BRUUN and FAULCONER
20	—	1.3764	—	—	,, (1937)
25	—	1.3738	—	—	,,
$\frac{dn}{dt}$	—	0.00052	—	—	,,
20	1.37470	1.37662	1.38114	1.38496	WIBAUT, HOOG, etc. (1939)
25	1.37197	1.37389	1.37842	1.38217	,,
$\frac{dn}{dt}$	0.00055	55	54	56	,,
20	—	1.37646	—	—	HOWARD, MEARS, etc. (1947)
25	—	1.37376	—	—	,,
$\frac{dn}{dt}$	—	0.00054	—	—	,,
20	—	1.3775	—	—	CRAMER and MULLIGAN (1936)

Specific heat: DOUSLIN and HUFFMAN (1946) (M. W. 86.172).

	t°	c_p	t°	c_p	t°	c_p	t°	c_p
Gl.	−222.27	0.13811	−180.55	0.39723	−116.12	0.42174	−42.50	0.46698
and	−215.08	0.15551	−173.59	0.39841	−105.93	0.42674	−30.72	0.47667
L.	−204.86	0.17379	−167.59	0.39920	− 95.89	0.43219	−18.27	0.48721
	−202.38	0.19148	−164.46	0.40047	− 86.02	0.43818	− 6.09	0.49824
	−198.79	0.21023	−158.82	0.40267	− 76.28	0.44372	+ 5.84	0.51014
	−196.01	0.30966	−155.51	0.40396	− 66.70	0.44989	17.52	0.52139
	−193.35	0.39460	−147.82	0.40699	− 57.25	0.45627	28.98	0.53321
	−188.57	0.39634	−137.04	0.41289	− 55.49	0.45728		
	−187.16	0.39713	−126.49	0.41712	− 47.94	0.46319		

BI-*iso*-PROPYL or 2, 3-DIMETHYLBUTANE $(CH_3)_2CH-CH(CH_3)_2$

Preparation in a state of purity

a) by hydrogenation of tetramethylethylene obtained from pinacolic alcohol (Van Risseghem, 1924)

b) by the action of sodium on *iso*-propyl iodide (very bad yield) (Young and Fortey, 1900)

c) from acetone (Brooks, Howard and Crafton, 1940).

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. mm.	d cr.	
227.1	23560	0.241	Kay (1946)
227.35	23345	0.2411	Young (1900–10)
227.4	23332	—	Kelso and Felsing (1942)

Densities of the liquid and the saturated vapour: Young (1910).

t°	L.	V.	t°	L.	V.
0	0.67948	0.0004	140	0.5334	0.02364
10	0.6707	0.0006	150	0.5197	0.02825
20	0.6617	0.0009	160	0.5049	0.03521
30	0.6525	0.0013	170	0.4885	0.04292
40	0.6432	0.0018	180	0.4705	0.05218
50	0.6338	0.002571	190	0.4508	0.06361
60	0.6243	0.003479	200	0.4274	0.07831
70	0.6144	0.004619	210	0.3988	0.09862
80	0.6039	0.006024	216	0.3758	0.1163
90	0.5931	0.007782	220	0.3565	0.1321
100	0.5821	0.009921	223	0.3372	0.1488
110	0.5708	0.01248	225	0.3198	0.1640
120	0.5589	0.01555	226.5	0.2967	0.1849
130	0.5464	0.01927	227.35	0.2411	0.2411

Rectilinear diameter: $0.3401 + 0.0004445\ t^\circ - 0.0000000413\ t^{\circ 2}$ Young (1900)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−10	45.20	80	1444	170	9806	Young (1900–10) and
0	75.95	90	1876	180	11535	Young and Fortey (1900)
10	123.45	100	2411	190	13475	„
20	190.55	110	3044	200	15693	„
30	285.1	120	3790	210	18208	„
40	411.6	130	4677	216	19848	„
50	584.8	140	5717	220	21009	„
60	807	150	6884	225	22588	„
70	1093	160	8256	227.35	23360	
14.256	149.42	39.150	402.44	57.790	755.26	Willingham, Taylor,
18.044	175.90	45.339	500.71	58.320	767.99	Pignocco and Rossini
23.099	217.18	52.060	627.94	58.789	779.37	(1945).
27.746	261.75	56.806	732.09			„
33.357	324.93	57.317	744.07			„

Boiling point

57°97	Lemons and Felsing (1943)	58°02	Stull (1937)
57°988	Forziati, Glasgow Jr., Willingham and Rossini (1946)	58°022	Wojciechowski (1939)
		58°03	Kay (1946)
57°999	Brooks, Howard and Crafton (1940)	58°06	Van Risseghem (1921)
		58°1	Young (1900–10)

$\frac{dt}{dp}$ *(10 mm)*

0°412	Brooks, Howard and Crafton (1940)	0°4173	Forziati, Glasgow Jr., etc. (1946)
0°417	Wojciechowski (1939)		

Freezing point

−128°798	Forziati, etc. (1946)	−128°41	Glasgow Jr., Murphy, Willingham and Rossini (1946)

Triple point: —127°97 Douslin and Huffman (1946)

Transition point: —137°09 „

Isotherms: Young (1900 –10), Young and Fortey (1900), Kelso and Felsing (1942)

Constants of state

Density

t°	d		t°	d	
0	0.67948	Young (1910)	20	0.6614	Van Risseghem (1938)
10	0.6707	"	20	0.66150	Brooks, Howard and Crafton (1940)
15	0.6662	"			
20	0.6617	"	25	0.65699	"
30	0.6525	"	20	0.66164	Forziati, Glasgow Jr., etc.
40	0.6432	"	25	0.65702	" (1946)
0	0.6795	Van Risseghem (1938)	20	0.6615	Kay (1946)
15	0.6659	"	20	0.6615	Lemons and Felsing (1943)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
0	495	25	361	Chavanne and Van Risseghem (1922)
15	409	30	342	"

Refractive index

t°	Hα	D	Hβ	Hγ	
15°	1.3790	1.3809	1.3855	1.38935	Van Risseghem (1924–38)
20°	—	1.37490	—	—	Brooks, Howard and Crafton (1940)
25°	—	1.37212	—	—	"
$\frac{dn}{dt}$	—	0.000556	—	—	"
20°	—	1.37495	—	—	Forziati, Glasgow Jr., etc. (1946)
25°	—	1.37231	—	—	"
$\frac{dn}{dt}$	—	0.00053	—	—	"
20°	—	1.3748	—	—	Lemons and Felsing (1943)
20°	—	1.3749	—	—	Mc Ardle and Robertson (1942)

Specific heat: Douslin and Huffman (1946) (M. W. 86.172)

t°	c_p	t°	c_p	t°	c_p
C. I −259.42	0.01250	−166.36	0.23242	−76.59	0.43459
−257.84	0.01701	−159.59	0.24496	−67.72	0.44071
−257.70	0.01741	−158.05	0.24659	−66.47	0.44108
−255.92	0.02274	−153.15	0.25733	−58.98	0.44641
−253.49	0.03164	−149.13	0.26522	−50.36	0.45327
−253.16	0.03251	−147.24	0.26918	−49.23	0.45409
−250.35	0.04318	−147.01	0.26991	−41.87	0.46019
−249.51	0.04620	−141.71	0.28243	−33.50	0.46718
−247.06	0.05496	C. II −135.55	0.38186	−32.48	0.46768
−245.47	0.06030	−134.86	0.38130	−25.25	0.47380
−243.77	0.06592	−134.02	0.38075	−20.18	0.47835
−240.89	0.07559	L. −123.79	0.40322	−17.11	0.48151
−240.28	0.07753	−122.15	0.40467	−12.15	0.48553
−236.44	0.08901	−118.97	0.40669	− 8.32	0.49025
−235.50	0.09085	−114.19	0.40956	− 4.25	0.49349
−232.07	0.1008	−112.69	0.41008	+ 1.24	0.49848
−227.20	0.1128	−109.46	0.41287	3.54	0.50188
−221.99	0.12485	−104.76	0.41578	11.23	0.50895
−220.64	0.12810	−104.04	0.41661	18.81	0.51680
−211.74	0.14676	−103.26	0.41799	26.28	0.52459
−202.30	0.16523	−100.13	0.41909	33.30	0.53225
−193.98	0.18141	−95.51	0.42184		
−186.12	0.19638	−94.00	0.42237		
−185.94	0.19712	−85.60	0.42821		
−168.04	0.22952	−84.21	0.42922		

Heat of vaporisation	20°	81.0	cal 15°/g	Lemons and Felsing (1943)
	40°	78.1	„	„
	60°	74.9	„	„
	80°	72.3	„	„
Heat of transition		18.010	„	Douslin and Huffman (1946)
Heat of melting		2.2212	„	„

TRIMETHYLETHYLMETHANE or 2, 2-DIMETHYLBUTANE

$CH_3-C(CH_3)_2-CH_2-CH_3$

Prepared in a state of purity by hydrogenation of *tert.* butylacetylene obtained from pinacone. Van Risseghem (1922)

Constants. — Polyphasic equilibria

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−62.16	1.91	−22.87	33.11	+2.14	121.60	Kilpatrick and Pitzer
−54.41	4.05	−14.84	52.05	9.71	170.85	„ (1946)
−43.25	8.90	− 6.18	81.45	16.23	225.33	„
−32.46	18.52	0.00	110.12			„
15.376	217.18	37.269	500.71	49.544	755.26	Willingham, Taylor,
19.946	261.75	43.893	627.95	50.074	768.00	Pignocco and Rossini
25.472	324.93	48.575	732.09	50.329	779.38	„ (1945)
31.175	402.44	49.078	744.07			„

Boiling point

49°65	Pitzer (1941)	49°733	Howard, Mears, Fookson, Pomerantz and Brooks (1947)
49°70	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)	49°741	Forziati, Glasgow Jr., Willingham and Rossini (1946)
49°71	Felsing and Watson (1943)	49°80	Stull (1937)
49°72	Van Risseghem (1922)	49°804	Wojciechowski (1939)
49°72	Hicks-Bruun, Bruun and Faulconer (1939)	49°81	Cramer and Mulligan (1936)
49°731	Brooks, Howard and Crafton (1940)		

$\frac{dt}{dp}$ *(10 mm)*

0°407	Brooks, Howard and Crafton (1940)	0°4117	Forziati, Glasgow Jr., Willingham and Rossini (1946)
0°411	Wojciechowski (1939)		

Freezing point

−98°7	Hicks-Bruun, Bruun and Faulconer (1939)	−99°991	Forziati, Glasgow Jr., Willingham and Rossini (1946)
−99°00	Kilpatrick and Pitzer (1946)	−100°06	Brooks, Howard and Crafton (1940)
−99°73	Glasgow Jr., Murphy, Willingham and Rossini (1946)		

Triple point: —98°88 DOUSLIN and HUFFMAN (1946)

Transition points

Low	High	
−146°35	−132°28	KILPATRICK and PITZER (1946)
−146°35	−132°37	DOUSLIN and HUFFMAN (1946)

Critical solution point

in $C_6H_5NH_2$	80°65	THIRY (1925)
	80°75	VAN RISSEGHEM (1922)
	81°2	WIBAUT, HOOG, etc. (1939)

Constants of state

Density

t°	d		t°	d	
0	0.6677	CHAVANNE and VAN RISSEGHEM (1922)	20	0.64923	HOWARD, MEARS, etc. (1947)
			25	0.64422	,,
15	0.6541	,,	20	0.64899	FELSING and WATSON (1943)
0	0.6678	VAN RISSEGHEM (1938)	25	0.64433	,,
20	0.6491	,,	20	0.6494	HICKS-BRUUN, BRUUN and FAULCONER (1939)
20	0.64919	WIBAUT, HOOG, etc. (1939)			
25	0.64448	,,	25	0.64475	,,
20	0.64902	BROOKS, HOWARD and CRAFTON (1940)	20	0.64916	FORZIATI, etc. (1946)
			20	0.6493	CRAMER and MULLIGAN (1936)
25	0.64432	,,			

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
0	477	25	351	CHAVANNE and VAN RISSEGHEM (1922)
15	397	30	330	,,
20	375			,,

Surface tension: 20° 16.18 WIBAUT, HOOG, etc (1939)

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.3697	1.3716	1.3762	1.3801	Van Risseghem (1924–38)
20	1.36695	1.36887	1.37344	1.37719	Wibaut, Hoog, etc. (1939)
25	1.36413	1.36611	1.37057	1.37430	„
$\frac{dn}{dt}$	0.00056	55	57	58	„
20	—	1.36864	—	—	Brooks, Howard and Crafton (1940)
25	—	1.36592	—	—	„
$\frac{dn}{dt}$	—	0.00054	—	—	„
20	—	1.36876	—	—	Forziati, Glasgow Jr., etc. (1946)
25	—	1.36595	—	—	„
$\frac{dn}{dt}$	—	0.00056	—	—	„
20	—	1.36873	—	—	Howard, Mears, etc. (1947)
25	—	1.36585	—	—	„
$\frac{dn}{dt}$	—	0.00058	—	—	„
20	—	1.3689	—	—	Hicks-Bruun, Bruun and Faulconer
25	—	1.36613	—	—	„ (1939)
$\frac{dn}{dt}$	—	0.00055	—	—	„
20	—	1.3689	—	—	Mc Ardle and Robertson (1942)
20	—	1.3690	—	—	Woodburn, Smith and Tetewski (1944)

Heat constants

Specific heat

t°	c_p	t°	c_p	
C. I −257.64	0.01972	−234.39	0.09770	Kilpatrick and Pitzer (1946)
−256.62	0.02287	−229.88	0.10857	„ (M. W. 86.172)
−255.20	0.02804	−224.31	0.12152	„
−253.49	0.03457	−221.30	0.12805	„
−252.06	0.03996	−215.95	0.13883	„
−250.60	0.04535	−209.84	0.14962	„
−248.58	0.05346	−208.84	0.15107	„
−246.23	0.06243	−204.36	0.15978	„
−244.49	0.06826	−199.68	0.16802	„
−241.38	0.07856	−194.14	0.17791	„
−238.49	0.08701	−188.09	0.18973	„
−238.22	0.08800	−187.19	0.19100	„

Specific heat (continued)

t°	c_p	t°	c_p	
—183.88	0.19682	L. —94.43	0.4179	Kilpatrick and Pitzer (1946)
—182.81	0.19914	—85.65	0.4243	„ (M. W. 86.172)
—180.84	0.20274	—76.05	0.4319	„
—176.39	0.21086	—66.54	0.4384	„
—174.76	0.21376	—57.44	0.4454	„
—173.67	0.21563	—47.92	0.4540	„
—169.46	0.22353	—36.51	0.4642	„
—166.09	0.22875	—27.09	0.4726	„
—162.47	0.23613	—18.30	0.4815	„
—157.29	0.24497	—10.01	0.4892	„
—154.71	0.25042	— 1.45	0.4984	„
—149.43	0.26053	+ 6.41	0.5070	„
C. I —260.30	0.01099	—171.50	0.21956	Douslin and Huffman (1946)
—258.41	0.01668	—163.93	0.23376	„ (M. W. 86.172)
—255.94	0.02510	—154.58	0.25139	„
—252.67	0.03677	L. —95.91	0.41748	„
—248.86	0.05106	—93.10	0.41881	„
—244.74	0.06621	—92.08	0.42022	„
—240.02	0.08139	—87.70	0.42284	„
—234.40	0.09733	—82.90	0.42615	„
—227.33	0.1142	—77.59	0.43043	„
—220.54	0.12827	—67.67	0.43832	„
—220.29	0.12882	—57.92	0.44573	„
—219.94	0.12971	—48.23	0.45358	„
—211.90	0.14530	—38.87	0.46092	„
—208.28	0.15220	—29.62	0.46942	„
—202.32	0.16311	—20.49	0.47813	„
—196.73	0.17354	—11.52	0.48679	„
—192.92	0.18048	— 2.70	0.49612	„
—185.57	0.19454	+ 5.17	0.50430	„
—183.90	0.19759	14.52	0.51294	„
—174.03	0.21519	22.94	0.52151	„

N.B. — For C_{II} and C_{III} (polymorphic forms), the values given by the two works disagree and are somewhat erratic.

Heat of vaporisation	25°	76.794 cal 15°/g	Osborne and Ginnings (1947)
	50°	73.8 „	Pitzer (1941)
Heats of transition	Low (—146°)	High (—132°)	
	14.950	0.786 cal 15°/g	Kilpatrick and Pitzer (1946)
	15.001	0.7914 „	Douslin and Huffman (1946)
Heat of melting		1.6061	Kilpatrick and Pitzer (1946)
		1.607	Douslin and Huffman (1946)

n-HEPTANE $n\text{-}C_7H_{16}$

Preparation in a state of purity

a) from the essential oil of "*Pinus Sabiniana*" and purification by mixed sulphuric and nitric acid (THORPE, 1880)
b) by reduction of oenanthol (CLEMMENSEN, 1913)
c) by reduction of *n*-heptyl bromide or iodide by sodium ammonium (EDGAR, CALINGAERT and MARKER, 1929).

Heptane was the object of a series of systematic investigations by EDGAR, SMYTH, PARKS, KHARASCH and their collaborators and by SHEPARD and HENNE; the results agree with those of the B. E. and of BRUYLANTS.

Constants: B.E. (1935). — **Polyphasic equilibria**

Critical constants

t° cr	p cr mm	d cr	
267.01	20520	0.241	SMYTH, BEATTIE and KAY (1937)
266.85	20430	0.2341	YOUNG (1898–1900–1910)

N.B. The sample of EDGAR and CALINGAERT (1929) seems pure but the values disagree.

Densities of the liquid and the saturated vapour: YOUNG (1910)

t°	L.	V.	t°	L.	V.
0	0.70048	0.00007	100	0.6124	0.003597
10	0.6920	0.00010	110	0.6027	0.004706
20	0.6836	0.00020	120	0.5926	0.006075
30	0.6751	0.0003	130	0.5821	0.007764
40	0.6665	0.0005	140	0.5711	0.009785
50	0.6579	0.0007	150	0.5598	0.01222
60	0.6491	0.0011	160	0.5481	0.01511
70	0.6402	0.001460	170	0.5359	0.01848
80	0.6311	0.002000	180	0.5232	0.02242
90	0.6218	0.002703	190	0.5066	0.02711

Densities of the liquid and the saturated vapour: Young (1910) (continued)

t°	L.	V.	t°	L.	V.
200	0.4952	0.03304	260	0.3457	0.1287
210	0.4793	0.04005	262	0.3332	0.1397
220	0.4616	0.04892	264	0.3166	0.1538
230	0.4414	0.06002	265	0.3059	0.1631
240	0.4177	0.07446	266	0.2907	0.1778
250	0.3877	0.09461	266.5	0.2819	0.1895
256	0.3664	0.1117	266.56	0.2341	0.2341

Rectilinear diameter: $0.3504 + 0.0004192\ t° - 0.0000000621\ t°^2$ Young (1910)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−40.1	0.763	−52.4	0.259	−58.4	0.150	Mündel (1913)
−42.6	0.632	−56.4	0.179	−62.7	0.096	„
−46.7	0.440					„
0	11.45	100	795.2	200	7261	Young (1910)
10	20.50	110	1047	210	8594	„
20	35.50	120	1367	220	10105	„
30	58.35	130	1753	230	11810	„
40	92.05	140	2229	240	13790	„
50	140.9	150	2784	250	15980	„
60	208.9	160	3450	260	18470	„
70	302.3	170	4212	264	19610	„
80	426.6	180	5091	266.85	20430	„
90	588.8	190	6095			„
22.7	41.4	50.0	141.0	70.0	301.4	Smyth and Engel (1929)
30.0	58.2	51.2	150.0	79.5	419.7	„
30.3	58.8	61.2	220.0	98.4	760	„
38.4	86.0	69.5	297.8			„
40.009	92.52	74.489	355.22	104.530	906.06	Smith (1940)
45.637	108.06	80.402	433.56	110.681	1074.58	„
51.312	149.40	86.363	525.86	116.879	1268.03	„
57.035	187.57	92.371	633.99	123.125	1489.14	„
62.806	233.72	98.427	760.00	129.418	1740.77	„
68.624	289.13					„
25.925	47.48	51.320	149.41	92.053	627.85	Willingham, Taylor,
29.699	57.49	55.394	175.84	97.154	731.99	Pignocco, and Rossini
33.024	67.33	60.862	217.14	97.702	743.96	„ (1945)
36.017	77.34	65.882	261.75	98.207	755.23	„
38.822	87.76	71.930	324.97	98.773	768.01	„
42.599	103.67	78.169	402.39	99.285	779.37	„
46.929	124.54	84.823	500.66			„

Boiling point

98°35	B.E. (1935)	98°40	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)
98°365	Wojciechowski (1936)	98°41	Appleby, Avery and Meerbott (1947)
98°38	Shepard, Henne and Midgley (1931)	98°413	Smith and Matheson (1938)
98°38	Mair (1932)	98°413	Wojciechowski (1939)
98°4	Fawcett (1946)	98°422	Brooks (1938)
98°4	Marschner and Cropper (1946)	98°424	Brooks, Howard and Crafton (1940)
98°4	Lecat (passim)	98°426	Forziati, Glascow Jr., Willingham and Rossini (1946)
98°4	Young (1909–1910)	98°427	Smith (1940)
98°4	Edgar, Calingaert and Marker (1929)	98°43	Davies and Gilbert (1941)
98°4	Bromiley and Quiggle (1933)	98°43	Thorpe (1880)
98°4	Smyth and Engel (1929)	98°49	de Bruyne, Davis and Gross (1933)
98°4	Cummings, Stone and Volante (1933)	98°5	Mc Ardle and Robertson (1942)
98°4	Hicks-Bruun and Bruun (1932)		

$\frac{dt}{dp}$ *(10 mm)*

0°4480	Forziati, Glasgow Jr., Willingham and Rossini (1946)	0°45	Shepard, Henne and Midgley (1931)
0°448	Wojciechowski (1936–1939)	0°45	Young (1902–1910)
0°4485	Smith and Matheson (1938)	0°45	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)
0°4493	Brooks (1938)		
0°45	B.E. (1935) and Lecat (passim)		

Melting point

−90°5	Smyth and Engel (1929)	−90°64	Hicks-Bruun and Bruun (1932)
−90°5	Edgar, Calingaert, and Marker (1929)	−90°65	Appleby, Avery and Meerbott (1947)
−90°576	Brooks (1938)	−90°65	Shepard, Henne and Midgley (1931)
−90°595	Glasgow Jr., Murphy, Willingham and Rossini (1946)	−90°8	Bromiley and Quiggle (1933)
−90°6	Marschner and Cropper (1946)	−90°8	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)
−90°60	Brooks, Howard and Crafton (1940)	−90°9	Parks, Huffman and Thomas (1930)
−90°609	Forziati, Glasgow Jr., Willingham and Rossini (1946)		
−90°623	Mair (1932)		

Critical solution point in $C_6H_5NH_2$

69°9	Shepard, Henne and Midgley (1931)	70°0	Hicks-Bruun and Bruun (1932)
70°0	Edgar, Calingaert and Marker (1929)	70°1	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)

Isotherms: Young (1910) and Smyth, Beattie and Kay (1937)

Constants of state

Density

t°	d		t°	d	
0	0.70048	B.E. (1935)	20	0.68376	Smyth and Engel (1929)
15	0.68785	„	20	0.6838	Mathews (1926)
30	0.67522	„	20	0.6838	Appleby, Avery and
0	0.70048	Young (1910			Meerbott (1947)
10	0.6920	„	20	0.6839	Waterman and de Kok
15	0.6878	„			(1933)
20	0.6836	„	20	0.6839	Bromiley and Quiggle
30	0.6731	„			(1933)
0	0.7005	Thorpe (1880)	30	0.67520	de Bruyne, Davis and
14.9	0.68796	„			Gross (1933)
20	0.6836	„	0	0.7004	Smyth and Stoops (1928)
20	0.68367	Forziati, etc. (1946)	10	0.6921	„
25	0.67949	„	20	0.6838	„
20	0.6837	Quayle, Day and Brown	0	0.70008	Bruylants (unpubl.)
30	0.6752	„ (1944)	15	0.68793	„
40	0.6668	„	30	0.67538	„
50	0.6580	„	20	0.68378	Shepard, Henne and Mid-
12.2	0.69026	Perkin (1892)	25	0.67963	„ gley (1931)
20	0.6835	Fawcett (1946)	20	0.68378	Wibaut, Hoog, etc. (1939)
20	0.6836	Edgar, Calingaert and	25	0.67954	„
		Marker (1929)	20	0.68368	Brooks, Howard and
20	0.68370	Hicks-Bruun and Bruun			Crafton (1940)
		(1932)	25	0.67943	„
20	0.68372	Brooks (1938)	20	0.6836	Grosse and Wackher
					(1939)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	429	B.E. (1935)	0	521	Geist and Cannon (1946)
30	364	„	40	333	„
20	409	Smyth and Stoops (1928)	20	411	Fawcett (1946)

Viscosity (continued)

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
6.43	479.7	Thorpe and Rodger	62.04	271.4	„
6.56	479.5	„ (1894)	70.09	252.6	„
13.45	441.8	„	77.10	237.2	„
21.74	402.7	„	85.49	221.8	„
30.27	368.5	„	92.21	209.6	„
38.34	339.7	„	25	385.5	Lewis (1922)
47.25	311.2	„	25	385.9	Shepard, Henne and Midgley (1931)
55.03	289.0	„			

Surface tension

t°	γ		t°	γ	
0	22.19	Thorpe (1879)	20	20.30	Quayle, Day and Brown
10	21.12	„	30	19.29	„ (1944)
15	20.85	B.E. (1935)	40	18.32	„
20	20.35	„	50	17.20	„
30	19.27	„	20	20.26	Wibaut, Hoog, etc. (1939)
			20	20.28	Edgar and Calingaert (1929)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.38772	1.38806	1.39002	1.39019	1.39398	1.39495	1.39797	—	B. E. (1935)
$\frac{dn}{dt}$	0.00046	46	—	46	47	47	47	—	„
15	1.38784	1.38808	1.39001	1.39016	1.39389	1.39481	1.39764	1.39864	Bruylants (unp.)
30	1.38090	1.38141	1.38312	1.38314	1.38640	1.38781	1.39066	1.39117	„
$\frac{dn}{dt}$	0.00046	44	46	47	49	47	46	46	„
20	—	1.38573	1.38775	—	—	1.39247	—	1.39637	Wibaut, etc. (1939)
25	—	1.38322	1.38521	—	—	1.38987	—	1.39373	„
$\frac{dn}{dt}$	—	0.00050	51	—	—	52	—	53	„
20	—	—	1.38764	—	—	—	—	—	Brooks, Howard and Crafton (1940)
25	—	—	1.38511	—	—	—	—	—	
$\frac{dn}{dt}$	—	—	0.000506	—	—	—	—	—	
20	—	—	1.38764	—	—	—	—	—	Forziati, etc. (1946)
25	—	—	1.38517	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00049	—	—	—	—	—	„

Refractive index (continued)

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
12,2	—	1.38966	1.39178	—	—	1.39664	—	—	Perkin (1892)
20	—	1.38580	1.38775	—	—	1.39261	—	—	Shepard, Henne and Midgley (1931)
20	—	1.38579	1.38777	—	—	1.39248	—	1.39646	Smyth and Stoops (1928)
20	—	1.38584	1.38777	—	—	1.39251	—	1.39636	Dornte and Smyth (1930)
20	—	—	1.3876	—	—	—	—	—	MacArdle and Robertson (1942)
20	—	—	1.38763	—	—	—	—	—	Smyth and MacAlpine (1934)
20	—	—	1.38767	—	—	—	—	—	Smyth and Engel (1929)
20	—	—	1.38768	—	—	—	—	—	Davies and Gilbert (1941)
20	—	—	1.3877	—	—	—	—	—	Hicks-Bruun and Bruun (1932)
20	—	—	1.3877	—	—	—	—	—	Woodburn, Smith and Tetewsky (1944)
20	—	—	1.3877	—	—	—	—	—	Fawcett (1946)
20	—	—	1.3977	—	—	—	—	—	Marschner and Cropper (1946)
20	—	—	1.3877	—	—	—	—	—	Applebey, Avery and Meerbott (1947)
20	—	—	1.38771	—	—	—	—	—	Stearn and Smyth (1934)
20	—	—	1.38777	—	—	—	—	—	Edgar (1923)
20	—	—	1.38777	—	—	—	—	—	Brooks (1938)
20	—	—	1.3878	—	—	—	—	—	Bromiley, etc. (1933)
25	—	—	1.38510	—	—	—	—	—	Mair (1932)
30	—	—	1.38292	—	—	—	—	—	de Bruyne, etc. (1933)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −183.06	0.205	−127.86	0.287	+2.24	0.513	Parks, Huffman and Thomas (1930)
−182.56	0.206	−122.26	0.295	2.84	0.514	
−177.16	0.216	L. −85.16	0.480	6.34	0.517	,,
−170.56	0.226	−73.16	0.480	14.34	0.522	,,
−163.56	0.236	−55.76	0.484	18.14	0.525	,,
−150.96	0.254	−37.36	0.489	21.04	0.527	,,
−144.66	0.263	−32.76	0.491	26.04	0.530	,,
−138.56	0.271	−15.16	0.500			,,
−132.66	0.280	−10.66	0.504			,,

Specific heat of the vapour: Waddington, Todd and Huffman (1947)

Heat of vaporisation	90°48	76.997 cal 15°/g	Waddington, Todd and Huffman
	77°33	79.223 „	„ (1947)
	58°06	82.277 „	„
	25°	87.175 „	Osborne and Ginnings (1947)
Heat of melting		33.78 „	Parks, Huffman and Thomas (1930)
Heat of combustion	30°	(c_p) 11479.3 „	Jessup (1937) (M. W. 100.1926)
	25°	(c_p) 11485.7 „	„
	25°	(c_p) 11493.4 „	Davies and Gilbert (1941)
	25°	(c_p) 11490.5 „	Prosen and Rossini (1944) (M. W. 100.198)

ISOMERIC HEPTANES

Their synthesis in a state of purity has been carried out by Chavanne and his collaborators, and also by Edgar, Calingaert and Marker, whose samples were used for other measurements by Edgar, Smyth, Huffman and Kharasch.

Usual method of preparation: Action of ketones, aldehydes or esters on Grignard's reagent in order to obtain a secondary alcohol, which is submitted to dehydration followed by catalytic hydrogenation.

2-METHYLHEXANE $CH_3—CH(CH_3)-(CH_2)_3-CH_3$

Obtained by extraction from petroleum: Bruun and Hicks-Bruun (1933)

Constants

Critical constants

t° cr.	p cr. atm.	
257.9	27.2	Edgar and Calingaert (1929)

Boiling point

89°67	Bruun and Hicks-Bruun (1933)	90°08	Davies and Gilbert (1941)
90°0	Edgar, Calingaert and Marker (1929)	90°10	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg, (1939)

Freezing point

−118°2	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg, (1939)	−119°1	Edgar, Calingaert and Marker (1929)
−118°9	Bruun and Hicks-Bruun (1933)	−119°1	Parks, Huffman and Thomas (1930)

Critical solution point

in $C_6H_5NH_2$	73°6	Wibaut, Hoog, etc. (1939)
	74°1	Edgar, Calingaert and Marker (1929)
	74°1	Bruun and Hicks-Bruun (1933)

Density

t°	d		t°	d	
20	0.6789	Edgar, Calingaert and Marker (1929)	20	0.67869	Wibaut, Hoog, etc. (1939)
25	0.6746	„	25	0.67437	„
25	0.67492	Bruun and Hicks-Bruun (1933)			

Viscosity: 20° $378\cdot10^{-5}$ Smyth and Stoops (1928)

Surface tension

t°	γ	
20	19.17	Wibaut, Hoog, etc. (1939)
20	19.37	Edgar, Calingaert and Marker (1929)

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.38311	1.38509	1.38983	1.39377	Smyth and Stoops (1928)
20	1.38292	1.38498	1.38967	1.39355	Wibaut, Hoog, etc. (1939)
25	1.38041	1.38240	1.38702	1.39091	„
$\frac{dn}{dt}$	0.00050	51	53	53	„
20	—	1.3850	—	—	Bruun and Hicks-Bruun (1933)
20	—	1.38478	—	—	Davies and Gilbert (1941)

Dielectric constant: 20° 1.922 Smyth and Stoops (1928)

Specific heat: Parks, Huffman and Thomas (1930)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −187.26	0.202	−165.76	0.237	L. −112.96	0.427	−32.86	0.480
−185.56	0.206	−164.56	0.239	−107.16	0.430	−17.76	0.491
−183.36	0.212	−158.76	0.249	− 92.86	0.439	+ 2.64	0.507
−180.66	0.217	−157.66	0.250	− 77.96	0.449	13.04	0.519
−179.06	0.219	−150.36	0.262	− 62.16	0.460	19.24	0.523
−171.76	0.229			− 48.16	0.469		

Heat of melting	21.16 cal 15°/g	Parks, Huffman and Thomas (1930)
Heat of combustion	25° (c_p) 11480.8 „	Davies and Gilbert (1941)

3-METHYLHEXANE $CH_3-CH_2-CH(CH_3)-(CH_2)_2-CH_3$

Constants

Critical constants

t° cr.	p cr. atm.	
262.4	28.1	Edgar and Calingaert (1929)

Boiling point

91°8	Edgar, Calingaert and Marker (1929)	91°8	Bocharov and Obolenzev (1946)
91°8	De Graef (1925)	91°96	Davies and Gilbert (1941)
91°879	$\frac{dt}{dp}$ *(10 mm):* 0°445 Wojciechowski (1939)		

Critical solution point

in $C_6H_5NH_2$	70°5 70°5	Edgar, Calingaert and Marker (1929) De Graef (1925)

Density

t°	d		t°	d	
15	0.6909	**De Graef** (1925)	20	0.6870	**Edgar, Calingaert** and **Marker** (1929)
20	0.6868	„	20	0.6870	**Botcharov** and **Obolenzev** (1946)

Viscosity

t°	$\eta \cdot 10^5$	
15	386	**De Graef** (1925)
30	329	„
20	372	**Smyth** and **Stoops** (1928)

Surface tension: 20° 19.56 **Edgar** and **Calingaert** (1929)

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.38677	1.38873	1.39343	1.39744	**Smyth** and **Stoops** (1928)
20	—	1.38857	—	—	**Davies** and **Gilbert** (1941)
20	—	1.3888	—	—	**Botcharov** and **Obolenzev** (1946)
20.4	1.3865	1.3884	1.3932	—	**De Graef** (1925)

Dielectric constant: 20° 1.930 **Smyth** and **Stoops** (1928)

Specific heat: **Huffman, Parks** and **Thomas** (1930)

t°	c_p	t°	c_p	t°	c_p	
C. −202.06	0.178	L. −182.16	0.395	−121.36	0.415	**Huffman, Parks** and **Thomas** (1930)
−198.46	0.187	−180.36	0.397	− 99.36	0.426	
−195.16	0.197	−178.06	0.398	− 77.46	0.440	„
−192.06	0.205	−174.06	0.398	− 53.36	0.457	„
−189.16	0.215	−166.86	0.400	− 30.06	0.472	„
		−154.26	0.403	+ 2.64	0.498	„
		−141.76	0.407	16.04	0.511	„

Heat of combustion	25° (c_p) 11488.1 cal 15°/g	**Davies** and **Gilbert** (1941)

3-ETHYLPENTANE or TRIETHYLMETHANE $C_2H_5-CH(C_2H_5)-C_2H_5$

Constants

Saturated vapour pressure: Smith (1941)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
35.127	92.52	52.113	187.57	75.449	433.56	105.726	1074.58
40.740	118.06	57.873	233.72	81.406	525.86	111.929	1268.03
46.402	149.40	63.682	289.13	87.412	633.99	118.182	1489.14
		69.541	355.22	99.572	906.06		

Boiling point

93°368	Wojciechowski (1939)	93°468	Smith (1940)
93°37	Davies and Gilbert (1941)	93°473	Brooks, Howard and Crafton (1940)

$\frac{dt}{dp}$ *(10 mm)*

0°446	Brooks, Howard and Crafton (1940)	0°448	Wojciechowski (1939)

Freezing point

−118°605	Streiff, Murphy, Sedlak, Willingham and Rossini (1946)	−118°8	Huffman, Parks and Thomas (1930)
−118°65	Brooks, Howard and Crafton (1940)		

Density

t°	d	
20	0.69818	Brooks, Howard and Crafton (1940)
25	0.69377	„

Refractive index

t°	Hα	D	Hβ	Hγ	
20	—	1.39327	—	—	Davies and Gilbert (1941)
20	—	1.39337	—	—	Brooks, Howard and Crafton (1940)
25	—	1.39084	—	—	„
$\frac{dn}{dt}$	—	0.00051	—	—	„

Specific heat: Huffman, Parks and Thomas (1930)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −180.96	0.206	−154.26	0.248	L. −111.76	0.416	−14.66	0.486
−174.86	0.216	−147.96	0.259	−106.36	0.419	− 3.24	0.499
−168.16	0.227	−141.76	0.269	− 92.76	0.427	+ 9.04	0.505
−161.06	0.238	−135.96	0.282	− 72.96	0.442	14.34	0.510
				− 35.66	0.470	21.64	0.519

Heat of melting	22.56 cal 15°/g	Huffman, Parks and Thomas (1930)
Heat of combustion	25° (c_p) 11491.3 „	Davies and Gilbert (1941)

2,2-DIMETHYLPENTANE $(CH_3)_3C-(CH_2)_2-CH_3$

Methods of preparation

1⁰) by the action of sodium on a mixture of *n*-propyl bromide and *tertiary* butyl chloride.

2⁰) by chlorination of pinacolin, transformation into *pseudo*-butylacetylene, then into *tertiary* methylbutylacetylene by the action of dimethyl sulphate, and catalytic hydrogenation of the compound obtained.

3⁰) by dehydration, followed by catalytic · hydrogenation, of 2,2-dimethylpentanol-3 obtained by the reaction of propionic aldehyde on *tert.* butyl chloride.

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	
15.325	67.27	53.261	402.46	Willingham, Taylor, Pignocco and Rossini (1945)
18.253	77.31	59.362	500.72	,,
20.979	87.74	65.879	627.94	,,
24.670	103.68	72.945	627.70	,,
28.879	124.68	77.958	732.11	,,
33.160	149.46	78.496	744.07	,,
37.129	175.94	78.995	755.28	,,
42.454	217.21	79.550	768.04	,,
47.359	324.99	80.050	779.35	,,
80	775.20	160	5092.0	Fawcett (1946)
100	1352.80	180	7334.0	,,
120	2211.60	200	10184.0	,,
140	3435.20	210	11932.0	,,

Boiling point

79°2	Fawcett (1946)	79°210	Wojciechowski (1939)
79°201	Willingham, Taylor, etc (1945)	79°25	Davies and Gilbert (1941)
79°203	Forziati, Glasgow Jr., Willingham and Rossini (1946)	79°3	De Graef (1925)

$\frac{dt}{dp}$ (10 mm)

0°436	Willingham, Taylor, etc. (1945)	0°4394	Forziati, Glasgow Jr., etc. (1946)
0°439	Wojciechowski (1939)		

Freezing point

−123°794	Forziati, Glasgow Jr., etc. (1946)	−125°0	Huffman, Parks and Thomas (1930)
−124°0	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)		

Critical solution point

in $C_6H_5NH_2$	77°7	De Graef (1925)
	77°7	Edgar, Calingaert and Marker (1929)
	78°3	Wibaut, Hoog, etc. (1939)

Density

t°	d		t°	d	
0	0.6908	Smyth and Stoops (1928)	20	0.67388	Wibaut, Hoog, etc. (1939)
10	0.6823	„	25	0.66953	„
20	0.6738	„	20	0.67385	Forziati, Glasgow Jr., etc.
30	0.6652	„	25	0.66958	„ (1946)
15	0.6780	De Graef (1925)	20	0.6736	Fawcett (1946)
20	0.6738	„	20	0.6737	Edgar, Calingaert and Marker (1929)

Viscosity

t°	$\eta \cdot 10^5$	
15	401	De Graef (1925)
30	340	„
20	385	Smyth and Stoops (1928)

Surface tension: 20° 18.05 Wibaut, Hoog, etc. (1939)

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.38038	1.38233	1.38710	1.39106	Smyth and Stoops (1928)
20.6	1.3799	1.3820	1.3866	—	De Graef (1925)
20	1.38025	1.38226	1.38703	1.39092	Wibaut, Hoog, etc. (1939)
25	1.37763	1.37964	1.38429	1.38821	„
$\frac{dn}{dt}$	0.00052	52	55	54	„
20	—	1.38217	—	—	Forziati, Glasgow Jr., etc. (1946)
25	—	1.37955	—	—	„
$\frac{dn}{dt}$	—	0.00052	—	—	„
20	—	1.38209	—	—	Davies and Gilbert (1941)
20	—	1.3824	—	—	Fawcett (1946)

Specific heat: Huffman, Parks and Thomas (1930)

t°	c_p	t°	c_p	t°	c_p
C. −181.26	0.200	L. −119.96	0.388	−35.76	0.461
−175.26	0.210	−118.86	0.389	−16.36	0.478
−169.86	0.219	−110.96	0.395	+ 1.94	0.498
−161.96	0.234	− 95.66	0.407	7.14	0.505
−154.76	0.244	− 87.06	0.415	14.04	0.511
		− 73.36	0.428	20.94	0.518
		− 57.36	0.442		

Heat of vaporisation	25°	77.343 cal 15°/g	Osborne and Ginnings (1947)
Heat of melting		13.98 „	Huffman, Parks and Thomas (1930)
Heat of combustion	25° (c_p)	11454.3 „	Davies and Gilbert (1941)

2,3-DIMETHYLPENTANE or METHYLETHYL *iso*-PROPYLMETHANE

$(CH_3)_2-CH-CH(CH_3)-CH_2-CH_3$

Constants

Critical constants

t° cr.	p cr. atm.	
264.6	29.2	Edgar and Calingaert (1929)

Boiling point

89°7	Edgar, Calingaert and Marker (1929)	89°78	Davies and Gilbert (1941)
		90°	Chavanne and De Graef (1924)

89°787 $\frac{dt}{dp}$ *(10 mm):* 0°450 Howard, Mears, Fookson, Pomerantz and Brooks (1947)

Critical solution point

in $C_6H_5NH_2$	68°0	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)
	68°1	Chavanne and De Graef (1924)
	68°1	Edgar, Calingaert and Marker (1929)

Density

t°	d		t°	d	
0	0.7117	Chavanne and De Graef	20	0.69514	Wibaut, Hoog, etc. (1939)
15	0.6991	„ (1924)	25	0.69087	„
20	0.6950	„	20	0.69510	Howard, Mears, Fookson, Pomerantz and Brooks
20	0.6952	Edgar, Calingaert and Marker (1929)	25	0.69090	„ (1947)

Viscosity

t°	$\eta \cdot 10^5$	
15	436	Chavanne and De Graef (1924)
30	412	„

Surface tension

t°	γ	
20	19.65	Edgar and Calingaert (1929)
20	19.82	Wibaut, Hoog, etc. (1939)

Dielectric constant: 20° 1.942 Smyth and Stoops (1928)

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.3894	1.3918	1.3965	1.4002	Chavanne and De Graef (1924)
20	1.39005	1.39201	1.39675	1.40071	Smyth and Stoops (1928)
20	1.39007	1.39210	1.39680	1.40074	Wibaut, Hoog, etc. (1939)
25	1.38753	1.38957	1.39422	1.39811	„
$\frac{dn}{dt}$	0.00051	51	52	53	„
20	—	1.39193	—	—	Howard, Mears, etc. (1947)
25	—	1.38950	—	—	„
$\frac{dn}{dt}$	—	0.00049	—	—	„
20	—	1.39202	—	—	Davies and Gilbert (1941)

Specific heat: Huffman, Parks and Thomas (1930)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
Gl. −204.76	0.169	−183.96	0.376	−145.16	0.389	−62.36	0.442
−200.36	0.177	−182.76	0.374	−139.26	0.393	−39.16	0.459
−196.36	0.189	−181.06	0.374	−112.86	0.409	−33.06	0.465
−192.46	0.205	−178.96	0.376	−91.66	0.421	+ 4.04	0.496
		−168.46	0.380	−68.16	0.437	18.14	0.510
L. −186.36	0.377	−161.86	0.383				

Heat of vaporisation	25° 81.667 cal 15°/g	Osborne and Ginnings (1947)
Heat of combustion	25° (c_p) 11476.2 „	Davies and Gilbert (1941)

2,4-DIMETHYLPENTANE or DI *iso*-PROPYLMETHANE

$(CH_3)_2CH-CH_2-CH(CH_3)_2$

Prepared by the action of ethyl isovalerate on methylmagnesium iodide.

Constants

Boiling point

80°49	Davies and Gilbert (1941)	80°60	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)
80°508	Howard, Mears, Fookson, Pomerantz and Brooks (1947)	80°8	Chavanne and De Graef (1924)
		80°8	Marschner and Cropper (1946)

$\frac{dt}{dp}$ (10 mm)

0°42	Wibaut, Hoog, etc. (1939)	0°431	Howard, Mears, etc. (1947)

Freezing point

−119°1	Wibaut, Hoog, etc. (1939)	−120°4	Richards and Hargreaves (1944)
−119°2	Timmermans (passim)		
−119°265	Streiff, Murphy, Sedlak, Willingham and Rossini (1946)	−120°6	Marschner and Cropper (1946)
−119°86	Howard, Mears, etc. (1947)	−120°6	Huffman, Parks and Thomas (1930)

Critical solution point

in $C_6H_5NH_2$	78°6	Chavanne and De Graef (1924)
	78°7	Wibaut, Hoog, etc. (1939)

Density

t°	d		t°	d	
0	0.6899	Chavanne and De Graef (1924)	20	0.67275	Wibaut, Hoog, etc. (1939)
15	0.6769	,,	25	0.66837	,,
20	0.6731	,,	20	0.67315	Howard, Mears, etc. (1947)
			25	0.66879	,,

Viscosity

t°	$\eta \cdot 10^5$	
15	375	Chavanne and De Graef (1924)
20	360	,,

Surface tension: 20° 18.12 Wibaut, Hoog, etc. (1939)

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.3795	1.3814	1.3862	1.3900	Chavanne and De Graef (1924)
20	1.37956	1.38153	1.38620	1.39012	Wibaut, Hoog, etc. (1939)
25	1.37697	1.37892	1.38357	1.38745	,,
$\frac{dn}{dt}$	0.00052	52	53	53	,,
20	—	1.38165	—	—	Howard, Mears, etc. (1947)
25	—	1.37903	—	—	,,
$\frac{dn}{dt}$	—	0.00052	—	—	,,
20	—	1.38167	—	—	Davies and Gilbert (1941)
20	—	1.3817	—	—	Marschner and Cropper (1946)

Specific heat: Huffman, Parks and Thomas (1930)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −181.56	0.201	L. −112.96	0.400	−67.46	0.440	−11.76	0.495
−178.06	0.209	−111.96	0.402	−57.86	0.449	+ 2.24	0.505
−175.76	0.212	−101.46	0.410	−47.46	0.458	8.34	0.512
−168.96	0.223	− 91.76	0.417	−36.76	0.468	15.04	0.519
−161.56	0.237	− 76.86	0.430	−30.76	0.472	21.24	0.529
−153.16	0.254						

Heat of vaporisation	25° 78.448 cal 15°/g	Osborne and Ginnings (1947)
Heat of melting	15.95 „	Huffman, Parks and Thomas (1930)
Heat of combustion	25° (c_p) 11463.4 „	Davies and Gilbert (1941)

3,3-DIMETHYLPENTANE or DIMETHYLDIETHYLMETHANE

$CH_3-CH_2-C(CH_3)_2-CH_2-CH_3$

Prepared by the action of ethyl bromide on *tert.* amyl bromide (Würtz) or by the action of zinc diethyl on 1,1-dimethyl-1-iodopropane.

Constants

Boiling point

85°97	Davies and Gilbert (1941)	86°0	Edgar, Calingaert and Marker (1929)
86°10	$\frac{dt}{dp}$ *(10 mm)*: 0°44 Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)		

Freezing point

−134°9	Huffman, Parks and Thomas (1930)	−135°	Edgar, Calingaert and Marker (1929)
		−135°7	Wibaut, Hoog, etc. (1939)

Critical solution point

in $C_6H_5NH_2$	69°7	Wibaut, Hoog, etc. (1939)
	71°0	Edgar, Calingaert and Marker (1929)

Viscosity: 20° $454 \cdot 10^{-5}$ Smyth and Stoops (1928)

Density

t°	d	
20	0.6934	Edgar, Calingaert and Marker (1929)
20	0.69330	Wibaut, Hoog, etc. (1939)
25	0.68911	„

Surface tension

t°	γ	
20	19.44	Wibaut, Hoog, etc. (1939)
20	19.63	Edgar and Calingaert (1929)

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.38918	1.39114	1.39589	1.39987	Smyth and Stoops (1928)
20	1.38901	1.39097	1.39575	1.39964	Wibaut, Hoog, etc. (1939)
25	1.38652	1.38853	1.39322	1.39715	„
$\frac{dn}{dt}$	0.00050	49	50	50	„
20	—	1.39094	—	—	Davies and Gilbert (1941)
20	—	1.39114	—	—	Edgar, Calingaert and Marker (1929)

Dielectric constant: 20° 1.940 Smyth and Stoops (1928)

Specific heat: Huffman, Parks and Thomas (1930)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −180.86	0.192	L. −127.46	0.392	−77.66	0.421	+ 1.94	0.486
−175.66	0.201	−121.76	0.395	−62.66	0.432	6.14	0.492
−169.46	0.212	−112.46	0.400	−47.46	0.444	13.34	0.498
−164.46	0.223	−101.26	0.405	−33.26	0.456	18.74	0.505
−159.16	0.233	− 90.16	0.412	−20.46	0.466		
−154.96	0.243						
−150.16	0.254						

Heat of melting	16.86 cal 15°/g	Huffman, Parks and Thomas (1930)
Heat of combustion	25° (c_p) 11463.1 „	Davies and Gilbert (1941)

2,2,3-TRIMETHYLBUTANE or TRIMETHYL *iso*-PROPYLMETHANE

$(CH_3)_3C-CH(CH_3)_2$

Prepared by the action of pinacolin on methylmagnesium iodide.

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. atm.	
258.3	29.75	Edgar and Calingaert (1929)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
22.696	92.52	51.122	289.13	80.872	760.00	Smith (1940)
28.275	118.06	56.966	355.22	86.981	906.06	„
33.907	149.40	62.863	453.56	93.142	1074.58	„
39.593	187.57	68.813	525.86	99.357	1268.03	„
45.331	233.72	74.816	630.99	105.625	1489.14	„
80.9	760	90.6	1000	103.2	1400	Fawcett (1946)
82.6	800	97.3	1200	108.6	1600	„
86.8	900					„

Boiling point

80°75	Chavanne and Van Risseghem (1922)	80°89	Davies and Gilbert (1941)
80°8	Harrison and Berg (1946)	80°9	Edgar, Calingaert and Marker (1929)
80°872	Smith (1940)	80°9	Fawcett (1946)
80°879	Brooks, Howard and Crafton (1940)		

$\frac{dt}{dp}$ (10 mm)

0°449	Brooks, Howard and Crafton (1940)

Freezing point

−24°96	Glasgow Jr., Murphy, Willingham and Rossini (1946)	−25°059	Brooks, Howard and Crafton (1940)
−25°	Edgar, Calingaert and Marker (1929)	−25°4	Huffman, Parks and Thomas (1930)
−25°	Timmermans (passim)		

Critical solution point

in $C_6H_5NH_2$	72°2	Wibaut, Hoog, etc. (1939)
	72°4	Edgar, Calingaert and Marker (1929)

Constants of state

Density

t°	d		t°	d	
0	0.7065	Chavanne and Van Risseghem (1922)	20	0.69000	Brooks, Howard and Crafton (1940)
15	0.6945	”	25	0.68576	”
20	0.69007	Wibaut, Hoog, etc. (1939)	20	0.6896	Fawcett (1946)
25	0.68583	”	20	0.6900	Edgar, Calingaert and Marker (1929)

Viscosity

t°	$\eta \cdot 10^5$	
20	579	Fawcett (1946)
20	585	Smyth and Stoops (1928)

Surface tension

t°	γ	
20	18.60	Edgar and Calingaert (1929)
20	18.86	Wibaut, Hoog, etc. (1939)

Dielectric constant: 20° 1.930 Smyth and Stoops (1928)

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.3903	1.3923	1.3971	1.4008	Chavanne and Lejeune (1922)
20	1.38744	1.38940	1.39419	1.39817	Smyth and Stoops (1928)
20	1.38751	1.38954	1.39430	1.39822	Wibaut, Hoog, etc. (1939)
25	1.38494	1.38695	1.39168	1.39561	„
$\frac{dn}{dt}$	0.00051	52	52	52	„
20	—	1.38947	—	—	Brooks, Howard and Crafton (1940)
25	—	1.38683	—	—	„
$\frac{dn}{dt}$	—	0.00053	—	—	„
20	—	1.3891	—	—	Marschner and Cropper (1946)
20	—	1.3893	—	—	Harrison and Berg (1946)
20	—	1.3894	—	—	Mac Ardle and Robertson (1944)
20	—	1.3894	—	—	Fawcett (1946)
20	—	1.38943	—	—	Davies and Gilbert (1941)

Heat constants

Specific heat

t°	c_p	t°	c_p	
C. I. −183.66	0.212	C. II. −62.46	0.409	Huffman, Parks and Thomas
−180.96	0.222	−51.16	0.422	„ (1930)
−178.36	0.232	−42.66	0.431	„
−156.86	0.310	−39.56	0.435	„
−143.56	0.321	−36.96	0.439	„
−141.96	0.324			„
−136.26	0.329	L. −19.96	0.459	„
−124.66	0.341	−14.66	0.463	„
−111.36	0.354	+ 2.54	0.479	„
− 98.36	0.366	8.44	0.485	„
− 74.06	0.380	20.74	0.497	„

Specific heat of the vapour: Waddington, Todd and Huffman (1947)

Heat of vaporisation	25°	76.423 cal 15°/g	Osborne and Ginnings (1947)
	80°80	69.04 „	Waddington, Todd and Huffman
	40°68	74.46 „	„ (1947)
Heat of melting		5.25 „	Huffman, Parks and Thomas (1930)
Heat of combustion	25° (c_p)	11465.3 „	Davies and Gilbert (1941)
	25° (c_p)	11449.53 „	Coops, Mulder, Dienske and Smittenberg (1946) (M. W. 100.198)

n-OCTANE n-C_8H_{18}

Methods of preparation

1⁰) From *n*-butyl bromide (Würtz's reaction) B.E. (1928)

2⁰) Reduction of octyl iodide (Young, 1900)

3⁰) By fractionation of petroleum ether after previous treatment with chlorosulphonic acid (Shepard, Henne and Midgley, 1931).
This sample has been used by Smyth, Huffman and Kharasch for their determinations.

Constants: B.E. (1928)

The published values (B.E., 1928) of the density and the refractive index have been corrected in the light of new experiments and agree with those of Bruylants.

Maman (1937—38) has studied a series of octanes, but when a comparison is possible, his results do not agree with those of other authors except for *n*-octane.

Polyphasic equilibria

Critical constants

t° cr.	p cr. mm	d cr.	
296.2	18730	0.2327	Young (1900–10)

Rectilinear diameter: $0.3592 - 0.0003986\ t° - 0.0000000960\ t°^2$ Young (1910) (corr. 1900)

Densities of the liquid and the saturated vapour: Young (1910)

t°	L.	V.	t°	L.	V.
0	0.71848	—	160	0.5772	0.008591
10	0.7102	—	170	0.5667	0.01071
20	0.7022	(0.0001)	180	0.5556	0.01316
30	0.6942	0.0001	190	0.5441	0.01613
40	0.6860	0.0002	200	0.5317	0.01965
50	0.6778	0.0003	210	0.5189	0.02364
60	0.6694	0.0004	220	0.5053	0.02874
70	0.6611	0.0006	230	0.4901	0.03484
80	0.6525	0.0009	240	0.4732	0.04237
90	0.6438	0.0013	250	0.4554	0.05118
100	0.6351	0.0017	260	0.4364	0.06223
110	0.6260	0.0023	270	0.4123	0.07716
120	0.6168	0.003247	280	0.3818	0.09833
130	0.6071	0.004219	290	0.3365	0.1346
140	0.5973	0.005405	296.2	0.2327	0.2327
150	0.5875	0.006863			

Saturated vapour pressure

t°	p mm		t°	p mm	
−35.1	0.167	Mündel (1913)	−9.3	1.47	Linder (1931)
−30.1	0.280	„	−3.0	2.32	„
−20.1	0.633	„	+3.7	3.65	„
−10.1	1.384	„			

t°	p mm	t°	p mm	t°	p mm	
0	2.94	110	481.9	210	4927	Young (1900–10)
10	5.62	120	646.4	220	5873	„
20	10.45	130	859	230	6948	„
30	18.40	140	1114	240	8219	„
40	30.85	150	1425	250	9612	„
50	49.35	160	1807	260	11185	„
60	77.55	170	2255	270	12980	„
70	117.9	180	2776	280	15015	„
80	174.48	190	3382	290	17126	„
90	253.5	200	4099	296.2	18730	„
100	353.6					„
52.927	57.53	80.134	175.82	118.924	627.77	Willingham, Taylor, Pignocco and Rossini (1945)
56.456	67.35	85.916	217.16	124.319	731.94	
59.616	77.36	91.230	261.73	124.899	743.92	
62.592	87.77	97.635	324.97	125.433	755.03	„
66.587	103.68	104.233	402.38	126.035	767.96	„
71.163	124.57	111.277	500.61	126.570	779.32	„
75.820	149.40					„

Boiling point

125°4	Bromiley and Quiggle (1933)	125°658	Wojciechowski (1936)
125°5	Vogel (1946)	125°665	Forziati, Glasgow Jr., Willingham and Rossini (1946)
125°59	Shepard, Henne and Midgley (1931)	125°75	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)
125°59	Mair (1932)	125°75	Lecat (passim)
125°6	Bruylants (unpub.)	125°80	B. E. (1928)
125°6	Mündel (1913)	125°8	Young (1900)
125°6	Rosenbaum (1941)		
125°6	Felsing and Watson (1942)		
125°60	Chavanne and Tock (1932)		

$\frac{dt}{dp}$ (10 mm)

0°47	B. E. (1928)	0°48	Shepard, Henne and Midgley (1931)
0°4738	Forziati, Glasgow Jr., etc. (1946)	0°48	Wibaut, Hoog, etc. (1939)
0°477	Wojciechowski (1936)	0°48	Lecat (passim)
0°48	Young (1910)		

Freezing point

−56°8	Wibaut, Hoog, etc. (1939)	−56°828	Mair (1932)
−56°8	B. E. (1928)	−56°84	Ralston, Hoerr and Crews (1944)
—56°807	Streiff, Murphy, Sedlak, Willingham and Rossini (1946)	−56°90	Shepard, Henne and Midgley (1931)
−56°808	Forziati, Glasgow Jr., etc. (1946)	−56°90	Felsing and Watson (1942)

Isotherms: Young (1900—10) and Felsing and Watson (1942)

Critical solution point

in $C_6H_5NO_2$	20°00	B. E. (1928)
in $C_6H_5NH_2$	71°8	Chavanne and Simon (1919) (corr. 1919, 72°)
	71°8	Shepard, Henne and Midgley (1931)
	72°1	Wibaut, Hoog, etc. (1939)

Constants of state

Density

t°	d		t°	d	
0	0.71852	B. E. (1928)	20	0.70279	Shepard, Henne and Midgley (1931)
15	0.70657	„			
30	0.69440	„	25	0.69882	„
0	0.71850	Bruylants (unp.)	20	0.7028	Vogel (1946)
15	0.70665	„	40.9	0.6861	„
30	0.69450	„	61.1	0.6700	„
0	0.71848	Young (1910)	84.9	0.6497	„
10	0.7102	„	20	0.70280	Wibaut, Hoog, etc. (1939)
20	0.7022	„	25	0.69878	„
30	0.6942	„	20	0.7027	Quayle, Day and Brown
40	0.6860	„	30	0.6945	„ (1944)
50	0.6778	„	40	0.6862	„
0	0.71854	Young and Fortey (1903)	50	0.6781	„
20	0.7026	Bromiley and Quiggle (1933)	20	0.70252	Forziati, Glasgow Jr.,
			25	0.69849	„ etc. (1946)
20	0.7027	Chavanne and Tock (1932)			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	579	B. E. (1928)	20	542	Geist and Cannon (1946)
30	472	„	25	508.3	Shepard, Henne and Midgley (1931)

Surface tension

t°	γ		t°	γ	
10	22.73	Harkins and Cheng (1921)	20	21.80	Quayle, Day and Brown
20	21.77	„	30	20.75	„ (1944)
30	20.76	„	40	19.84	„
15	22.27	Hennaut-Roland and Lek (1931) (corr. Lek, 1930)	50	18.82	„
			22.9	21.32	Vogel (1946)
20	21.75	„	23.5	21.26	„
30	20.79	„	40.7	19.66	„
20	21.7	Smith (1944)	60.3	17.92	„
20	21.71	Wibaut, Hoog, etc. (1939)	86.0	15.59	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.39736	1.39774	1.39974	1.39991	1.40377	1.40480	1.40775	—	B. E. (unp.)
$\frac{dn}{dt}$	0.00044	45	—	45	45	46	46	—	„
15	1.39753	1.39777	1.39973	1.39992	1.40377	1.40466	1.40758	1.40872	Bruylants (unp.)
30	1.39091	1.39137	1.39311	1.39320	1.39670	1.39809	1.40087	1.40202	„
$\frac{dn}{dt}$	0.00044	43	44	45	47	44	45	45	„
20	—	1.39557	1.39760	—	—	1.40255	—	—	Shepard, Henne
25	—	1.39328	1.39534	—	—	1.40030	—	—	and Midgley
45.3	—	1.38334	1.38561	—	—	1.39037	—	—	„ (1931)
$\frac{dn}{dt}$	—	0.00049	48	—	—	49	—	—	„
20	—	1.39562	1.39770	—	—	1.40252	—	1.40648	Wibaut, Hoog, etc.
25	—	1.39321	1.39530	—	—	1.40004	—	1.40411	„ (1939)
$\frac{dn}{dt}$	—	0.00048	48	—	—	50	—	47	„
20	—	—	1.39743	—	—	—	—	—	Forziati, Glasgow
25	—	—	1.39505	—	—	—	—	—	Jr., etc. (1946)
$\frac{dn}{dt}$	—	—	0.00048	—	—	—	—	—	„
20	—	1.39544	1.39743	—	—	1.40227	—	1.40576	Vogel (1946)
20	—	1.39559	1.39755	—	—	1.40238	—	1.40652	Dornte and Smyth (1930)
20	—	—	1.3975	—	—	—	—	—	Rosenbaum (1941)
20	—	—	1.39758	—	—	—	—	—	Felsing and Watson (1942)
25	—	—	1.39509	—	—	—	—	—	Mair (1932)

Magnetic rotatory power: Lowry (1913—14)

Heat constants

Specific heat: Huffman, Parks and Barmore (1931)
(corr. Huffman, Parks and Thomas (1930))

t°	c_p	t°	c_p	t°	c_p
C. −180.76	0.198	−132.96	0.263	L. −46.16	0.483
−175.86	0.207	−102.86	0.300	+ 1.84	0.508
−162.36	0.226	− 93.96	0.312	13.44	0.517
				25.14	0.526

Heat of vaporisation	25°	86.800 cal 15°/g	Osborne and Ginnings (1947)
Heat of melting		43.21 „	Huffman, Parks and Barmore (1931)
Heat of combustion	19° (c_p)	11456.9 „	Banse and Parks (1933)
	25° (c_p)	11441.0 „	Jessup (1937) (M. W. 114.2178)
	30° (c_p)	11437.2 „	„

3-METHYLHEPTANE $CH_3-CH_2-CH(CH_3)-(CH_2)_3-CH_3$

Constants

Boiling point

119°0		Van Risseghem (1930)
119°05	$\frac{dt}{dp}$ *(10 mm)*: 0°53	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)

Critical solution point in $C_6H_5NH_2$: 72°2 Wibaut, Hoog, etc. (1939)

Density

t°	d		t°	d	
0	0.7219	Van Risseghem (1930)	20	0.7055	Quayle, Day and Brown (1944)
15	0.7095	„	30	0.6974	„
20	0.70584	Wibaut, Hoog, etc. (1939)	40	0.6892	„
25	0.70178	„	50	0.6811	„
20	0.7057	Botcharov and Obolenzev (1946)			

Surface tension

t°	γ		t°	γ	
20	21.31	Quayle, Day and Brown (1944)	20	21.2	Smith (1944)
30	20.34	„			
40	19.34	„			
50	18.43	„			

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.39656	1.39856	1.40344	1.40744	Wibaut, Hoog, etc. (1939)
25	1.39413	1.39621	1.40099	1.40493	„
$\frac{dn}{dt}$	0.00049	47	49	50	„
15.0	1.3990	1.4011	1.4059	1.4100	Van Risseghem (1930)
20	—	1.3986	—	—	Botcharov and Obolenzev (1946)

Heat of vaporisation: 25° 83.346 cal 15°/g Osborne and Ginnings (1947)

4-METHYLHEPTANE $CH_3-(CH_2)_2-CH(CH_3)-(CH_2)_2-CH_3$

Freezing point: Streiff, Murphy, Sedlak, Willingham and Rossini (1946)
Density and *surface tension:* Quayle, Day and Brown (1944)
Heat of vaporisation: Osborne and Ginnings (1947)

2-METHYLHEPTANE $(CH_3)_2-CH-(CH_2)_4-CH_3$ and

3-ETHYLHEXANE $CH_3-CH_2-CH(C_2H_5)-(CH_2)_2-CH_3$

Density and *surface tension:* Quayle, Day and Brown (1944)
Heat of vaporisation: Osborne and Ginnings (1947)

2,3 and 2,4-DIMETHYLHEXANES
$CH_3-CH(CH_3)-CH(CH_3)-(CH_2)_2-CH_3$ and $CH_3-CH(CH_3)-CH_2-CH(CH_3)-CH_2-CH_3$

Boiling and *critical solution points, surface tension* and *refractive index:* Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939); *heat of vaporisation:* Osborne and Ginnings (1947)

3,3-DIMETHYLHEXANE $CH_3-CH_2-C(CH_3)_2-(CH_2)_2-CH_3$

Boiling and *freezing points, density* and *refractive index:* Forziati, Glasgow Jr., Willingham and Rossini (1946); *heat of vaporisation:* Osborne and Ginnings (1947)

3,4-DIMETHYLHEXANE $CH_3-CH_2-CH(CH_3)-CH(CH_3)-CH_2-CH_3$

Boiling point, density, surface tension and *refractive index*: Vogel (1946); *heat of vaporisation:* Osborne and Ginnings (1947)

BI-*iso*-BUTYL or 2,5-DIMETHYLHEXANE $(CH_3)_2CH-CH_2-CH_2-CH(CH_3)_2$

Method of preparation

1° action of sodium upon *iso*-butyl bromide: Young (1910) and Young and Fortey (1900)

N.B. At the boiling point, *iso*-butyl bromide is partially converted into *tertiary* butyl bromide, this may contaminate the di-*iso*-butyl by traces of hexamethylethane; moreover complete elimination of brominated derivatives is extremely difficult.

2° electrolysis of a solution of potassium *iso*-valerate with a platinum anode.

Constants: B.E. (1932). — **Polyphasic equilibria**

Critical constants

t° cr	p cr mm	d cr	
276.8	18660	0.2366	Young (1910)

Densities of the liquid and the saturated vapour: Young (1910)

t°	L.	V.	t°	L.	V.
0	0.71021	—	150	0.5732	0.01070
10	0.7019	0.0001	160	0.5620	0.01321
20	0.6934	0.0002	170	0.5503	0.01613
30	0.6848	0.0002	180	0.5383	0.01959
40	0.6764	0.0004	190	0.5255	0.02375
50	0.6677	0.0005	200	0.5117	0.02874
60	0.6592	0.0008	210	0.4970	0.03484
70	0.6504	0.0012	220	0.4810	0.04202
80	0.6417	0.0016	230	0.4633	0.05094
90	0.6328	0.002339	240	0.4434	0.06223
100	0.6236	0.003017	250	0.4199	0.07680
110	0.6143	0.003990	260	0.3912	0.09699
120	0.6046	0.005219	270	0.3482	0.1321
130	0.5945	0.006720	274	0.3187	0.1572
140	0.5841	0.008540	276.8	0.2366	0.2366

Rectilinear diameter: $0.3550 - 0.0004115\ t^{\circ} - 0.0000000592\ t^{\circ 2}$ Young (1900—10)

Saturated vapour pressure: Young (1900)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
10	13.0	80	305.5	150	2116	220	7937
20	23.05	90	426.6	160	2645	230	9312
30	38.4	100	578.8	170	3243	240	10905
40	61.8	110	777.1	180	3938	250	12668
50	95.95	120	1020	190	4740	260	14651
60	145.2	130	1319	200	5670	270	16905
70	213.3	140	1685	210	6733	276.8	18660

Boiling point	109°2	$\frac{dt}{dp}$ *(10 mm)*	0°47	Young (1910)
	109°40	,,	0°45	B. E. (1932)
	109°4	,,	0°46	Lecat (passim)

Critical solution point	in $C_6H_5NO_2$	28°2	B. E. (1932)
	in $C_6H_5NH_2$	78°3	,,

Constants of state

Density

t°	d		t°	d	
0	0.71020	B. E. (1932)	0°	0.71021	Young (1910)
15	0.69788	„	12°1	0.7001	Schiff (1883)
30	0.68551	„			

Viscosity

t°	$\eta \cdot 10^5$	
15	512	B. E. (1932)
30	432	„

Surface tension

t°	γ	
15	20.21	B. E. (1932)
20	19.66	„
30	18.87	„
20	19.8	Smith (1944)

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.39223	1.39265	1.39481	1.39876	1.39983	1.40282
$\frac{dn}{dt}$	0.00043	44	45	45	45	47

Heat constants

Heat of vaporisation: 25° 79.217 cal 15°/g Osborne and Ginnings (1947)

2,2,3-TRIMETHYLPENTANE $(CH_3)_3C-CH(CH_3)-CH_2-CH_3$

The values of Laughlin and Whitmore (1933) disagree with these of Maman (1938) and of Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)

Constants

Boiling point	109°843	$\frac{dt}{dp}$ *(10 mm)*	0°480	Brooks, Howard and Crafton (1940)
	109°847	„	0°487	Howard, Mears, Fookson, Pomerantz and Brooks (1947)

Freezing point: —112°32 Brooks, Howard and Crafton (1940)

Density

t°	d		t°	d	
20	0.71617	Brooks, Howard and Crafton (1940)	20	0.71608	Howard, Mears, etc.
25	0.71218	,,	25	0.71201	,, (1947)

Refractive index

t°	n_D		t°	n_D	
20°	1.40285	Brooks, Howard and Crafton (1940)	20°	1.40280	Howard, Mears, etc.
25°	1.40038	,,	25°	1.40052	,, (1947)
$\frac{dn}{dt}$	0.000494	,,	$\frac{dn}{dt}$	0.00049	,,

2,2,4-TRIMETHYLPENTANE $(CH_3)_3C-CH_2-CH(CH_3)_2$

Method of preparation: by dehydration of *tertiary* butylalcohol with sulphuric acid followed by catalytic hydrogenation of the octene (Edgar, 1927). This sample was used by the other workers whose observations corrected Edgar's values.

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. atm.	d cr.	
271.15	25.50	0.237	Beattie and Edwards (1948)

Saturated vapour pressure

t°	p mm	
−30.5	1.08	Linder (1931)
−19.0	2.58	,,

t°	p mm	t°	p mm	t°	p mm	
38.853	92.52	74.428	355.22	111.961	1074.58	Smith (1940)
40.646	118.06	80.548	433.56	118.406	1268.03	,,
50.494	149.40	86.722	525.86	124.906	1489.14	,,
56.396	187.57	92.950	633.99	131.460	1740.77	,,
62.353	233.72	99.232	760.00			,,
68.363	289.13	105.569	906.06			,,

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	
24.274	47.66	65.524	261.73	Willingham, Taylor, Pignocco and Rossini (1945)
28.201	57.42	71.781	324.97	„
31.620	67.23	78.240	402.47	„
34.722	77.28	85.141	500.76	„
37.609	87.72	92.634	627.98	„
41.519	103.67	97.926	732.14	„
45.977	124.65	98.495	744.13	„
50.505	149.39	99.022	755.32	„
54.711	175.91	99.610	768.10	„
60.346	217.22	100.138	779.50	„
150	2597.68	225	10040.36	Beattie and Edwards (1948)
175	4294.00	250	14459.76	„
200	6740.44			„

Boiling point

99°10	Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1939)	99°234	Smith and Matheson (1938)
		99°234	Brooks (1938)
		99°238	Forziati, Glascow Jr., Willingham and Rossini (1946)
99°2	Bromiley and Quiggle (1933)		
99°2	Harrison and Berg (1940)	99°24	Gelus, Marple Jr. and Miller (1949)
99°2	Marschner and Cropper (1946)		
99°232	Smith (1940)	99°3	Edgar (1927)
99°233	Brooks, Howard and Crafton (1940)	99°3	Laughlin and Whitmore (1933)
		99°3	Lecat

$\frac{dt}{dp}$ *(10 mm)*

0°4651	Brooks (1938); Smith and Matheson (1938) and Forziati, Glasgow Jr. Willingham and Rossini (1946)

Freezing point

−107°31	Brooks (1938)	−107°37	Brooks, Howard and Crafton (1940)
−107°31	Smith and Matheson (1938)		
−107°365	Glasgow Jr., Murphy, Willingham and Rossini (1946) and Streiff, Zimmerman, Soule, Butt, Sedlak, Willingham and Rossini (1948)	−107°4	Hicks-Bruun and Bruun (1932)
		−107°4	Marschner and Cropper (1946)
		−107°5	Timmermans (passim)
		−107°5	Bromiley and Quiggle (1933)

Critical solution point in $C_6H_5NH_2$: 80°4 Wibaut, etc. (1939)

Constants of state

Density

t°	d		t°	d	
0	0.7078	Smyth and Stoops (1928)	0	0.708120	Kretschmer, Nowakowska and Wiebe (1948)
10	0.6998	„			
20	0.6918	„	25	0.687773	„
30	0.6837	„	50	0.666855	„
20	0.6918	Laughlin and Whitmore (1933)	20	0.69189	Brooks, Howard and Crafton (1940)
20	0.69182	Brooks (1938)	25	0.68778	„
20	0.6919	Bromiley and Quiggle (1933)	20	0.69192	Forziati, Glasgow Jr., etc.
20	0.6918	Grosse and Wackher (1939)	25	0.68777	„ (1946)

Viscosity / *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
18.5	543	Edgar (1927)	20	18.85	Wibaut, Hoog, etc. (1939)
20	503	Smyth and Stoops (1928)	20	18.9	Smith (1944)

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.38962	1.39163	1.39649	1.40074	Smyth and Stoops (1928)
20	1.38944	1.39151	1.39640	1.40042	Wibaut, Hoog, etc. (1939)
25	1.38699	1.38906	1.39387	1.39792	„
$\frac{dn}{dt}$	0.00049	49	50	50	„
20	—	1.39155	—	—	Brooks, Howard and Crafton (1940)
25	—	1.38915	—	—	„
$\frac{dn}{dt}$	—	0.00048	—	—	„
20	—	1.39145	—	—	Forziati, Glasgow Jr., etc. (1946)
25	—	1.38901	—	—	„
$\frac{dn}{dt}$	—	0.00049	—	—	„
20	—	1.3913	—	—	Harrison and Berg (1946)
20	—	1.39144	—	—	Gelus, Marple Jr. and Miller (1949)
20	—	1.39146	—	—	Brooks (1938)
20	—	1.3915	—	—	Woodburn, Smith and Tetewsky (1944)
20	—	1.3915	—	—	Marschner and Cropper (1946)
20	—	1.3916	—	—	Laughlin and Whitmore (1933)
20	—	1.3916	—	—	Bromiley and Quiggle (1933)

Heat constants

Specific heat: PARKS, HUFFMAN and THOMAS (1930)

t°	c_p	t°	c_p	t°	c_p
C. −185.26	0.181	L. −103.56	0.388	−17.96	0.452
−181.26	0.190	− 99.76	0.390	+ 1.84	0.471
−174.96	0.201	− 95.36	0.393	5.24	0.475
−167.66	0.217	− 84.86	0.399	9.94	0.477
−159.96	0.232	− 74.76	0.403	14.44	0.482
−149.96	0.250	− 59.36	0.420	18.84	0.487
−143.76	0.260	− 54.66	0.422	22.04	0.489
−137.96	0.271	− 42.96	0.432		
−132.26	0.285				

Heat of vaporisation	25°	73.502 cal 15°/g	OSBORNE and GINNINGS (1947)
Heat of melting		18.92 „	PARKS, HUFFMAN and THOMAS (1930)

2,3,3-TRIMETHYLPENTANE (A) $(CH_3)_2CH-C(CH_3)_2-CH_2-CH_3$

2-METHYL-3-ETHYLPENTANE (B) $(CH_3)_2CH-CH(C_2H_5)-CH_2-CH_3$

2,3,4-TRIMETHYLPENTANE (C) $(CH_3)_2CH-CH(CH_3)-CH(CH_3)-CH_3$

Constants: (A) and (B) HOWARD, MEARS, POMERANTZ, FOOKSON and BROOKS (1947); (C) BROOKS, HOWARD and CRAFTON (1940)

	(A)	(B)	(C)
Boiling point	114°767	115°653	113°391
$\frac{dt}{dp}$ *(10 mm)*	0°491	0°477	0°479
Freezing point	−101°6	−114°94	−109°97;
Density 20°	0.72621	0.71931	0.71903
25°	0.72229	0.71523	0.71507
Refractive index n_D 20°	1.40757	1.40403	1.40431
25°	1.40521	1.40173	1.40193
$\frac{dn}{dt}$	0.00047	0.00046	0.000476

HEXAMETHYLETHANE $(CH_3)_3C-C(CH_3)_3$

2,2,3,3-TETRAMETHYLBUTANE

Prepared by the action of sodium on *tertiary* butyl bromide.

Constants

Saturated vapour pressure

t°	p mm		t°	p mm	
−10.3	1.33	Linder (1931)	−0.3	3.55	Linder (1931)
−5.0	2.08	,,	+6.0	5.80	,,

t°	p mm	t°	p mm	t°	p mm	
3.30	4.9	39.98	47.5	99.78	629.1	Calingaert, Soroos,
4.89	5.6	44.88	61.3	100.00	633.7	Hnizda and Shapiro
5.88	6.0	49.99	79.4	100.02	634.3	,, (1944)
9.87	7.8	54.88	100.3	100.03	634.6	,,
10.87	8.4	59.97	127.1	101.05	655.5	,,
14.88	10.9	64.87	158.4	102.03	674.5	,,
15.89	11.6	69.98	197.6	104.03	713.3	,,
19.90	14.9	79.96	298.8	106.07	755.3	,,
20.90	15.9	90.03	441.3	108.08	797.9	,,
24.91	20.4	95.00	530.1	109.57	831.8	,,
25.91	21.7	97.99	589.9			,,
30.02	27.8	98.98	611.3			,,
34.90	36.2	99.48	622.0			,,

Boiling point

106°30	$\frac{dt}{dp}$ *(10 mm):* 0°47	Calingaert, Soroos, Hnizda and Shapiro (1944)

Melting point

100°63	Seyer, Bennett and Williams (1949)
100°69	Calingaert, Soroos, Hnizda and Shapiro (1944)

Transition points

—125°06	Parks, Huffman and Thomas (1930)
74°25 and 96°65	Seyer, Bennett and Williams (1949)

Density: 100°71 0.6568; 102°81 0.6549 Seyer, Bennett and Williams (1949)

Specific heat: **Parks, Huffman** and **Thomas** (1930)

t°	c_p	t°	c_p	t°	c_p
C. I −184.36	0.166	− 94.36	0.332	− 22.66	0.427
−180.76	0.172	− 84.76	0.345	− 13.46	0.438
−174.86	0.183	− 78.86	0.353	+ 2.34	0.458
−167.36	0.198	− 68.76	0.369	7.84	0.466
−159.66	0.213	− 63.66	0.374	18.04	0.481
		− 49.36	0.394	22.24	0.486
C. II −111.86	0.308	− 44.06	0.400		
−100.16	0.326	− 30.66	0.417		

Heat of transition	—125°06	4.20 cal 15°/g	**Parks, Huffman** and **Thomas** (1930)

HIGHER PARAFFINS

The higher paraffins, which are liquid or crystalline at ordinary temperature, have generally been prepared by one of the following methods:

1⁰ Extraction from petroleum ether by treatment with chlorosulphonic acid, and fractional distillation (**Shepard, Henne** and **Midgley**, 1931).

2⁰ Reduction of the corresponding acid, ketone or iodide (**Krafft**, 1882).

3⁰ For even compounds: **Würtz** synthesis by the action of sodium on halogenated derivatives containing one half of the number of carbon atoms.

4⁰ For *iso* compounds: application of the **Grignard** method to aldehydes, formation of isomeric alcohols, dehydration and subsequent hydrogenation (method of **Edgar, Calingaert** and **Marker**).

Eykman, in his posthumous works, gave the refractive indices for eight wavelengths of a fair number of isomeric paraffins in C_8, C_9, C_{10}, etc.: his preparations were made with great care, but we do not, however, regard his values as reliable, since in those cases where there is material for comparison (e.g., di*iso*amyl) his results are not altogether exact.

n-NONANE n-C_9H_{20}

Constants

Boiling point

150°55	**Chavanne** and **Tock** (1932)	150°72	**Mair** (1932)
150°55	**Vogel** (1946)	150°73	**White** and **Rose** (1931)
150°71	**Shepard, Henne** and **Midgley** (1931)	150°81	**Wojciechowski** (1939)

$\frac{dt}{dp}$ *(10 mm)*

0°497	**Wojciechowski** (1939)

Freezing point

−53°535	**Streiff, Murphy, Cahill, Flanagan, Sedlak, Willingham** and **Rossini** (1947)	−53°68	**Shepard, Henne** and **Midgley** (1931)
−53°65	**White** and **Rose** (1931)	−53°70	**Mair** (1932)

Transition point: −56°46 **Huffman, Parks** and **Barmore** (1931)

Critical solution point in $C_6H_5NH_2$: 74°4 **Shepard, Henne** and **Midgley** (1931)

Density

t°	d		t°	d	
0	0.7330	**Krafft** (1882)	0	0.73300	**Bruylants** (unp.)
13.5	0.7228	„	15	0.72159	„
15	0.7217	„	30	0.70988	„
20	0.7177	„	20	0.7175	**Quayle, Day** and **Brown**
0	0.7330	**Chavanne** and **Tock** (1932)	30	0.7097	„ (1944)
20	0.7176	„	40	0.7020	„
20	0.71780	**Shepard, Henne** and **Midgley** (1931)	20	0.7174	**Vogel** (1946)
			41.5	0.7015	„
25	0.71328	„	61.8	0.6858	„
20	0.71793	**White** and **Rose** (1931)	85.6	0.6672	„

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
0	969	40	548	**Bingham** (1910)
10	824	60	438	„
20	711	80	359	„
30	619	100	209	„
25	662.1			**Shepard, Henne** and **Midgley** (1931)

Surface tension

t°	γ		t°	γ	
17.4	23.02	**Vogel** (1946)	20	22.91	**Quayle, Day** and **Brown** (1944)
20.6	22.80	„	30	21.92	„
26.3	22.28	„	40	20.96	„
41.4	20.79	„			
61.2	18.97	„			
87.7	16.67	„			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.40525	1.40553	1.40760	1.40773	1.41161	1.41258	1.41557	1.41654	**Bruylants** (unp.)
30	1.39883	1.39923	1.40115	1.40125	1.40474	1.40611	1.40901	1.41024	„
$\frac{dn}{dt}$	0.00043	42	43	43	45	43	44	42	„
20	—	1.40356	1.40563	—	—	1.41077	—	—	**Shepard, Henne**
25	—	1.40125	1.40340	—	—	1.40846	—	—	and **Midgley**
45.3	—	1.39181	1.39389	—	—	1.39883	—	—	„ (1931)
$\frac{dn}{dt}$	—	0.00047	47	—	—	48	—	—	„
20	—	1.40351	1.4055	—	—	1.41043	—	1.41458	**Dornte** and **Smyth** (1930)
20	—	1.40339	1.40543	—	—	1.41041	—	1.41420	**Vogel** (1946)
25	—	—	1.40335	—	—	—	—	—	**White** and **Rose** (1931)
25	—	—	1.4035	—	—	—	—	—	**Krafft** (1882)

Specific heat: **Huffman, Parks** and **Barmore** (1931)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −180.36	0.195	−123.06	0.271	L. −44.86	0.489	+ 2.14	0.508
−175.56	0.203	−110.06	0.288	−39.46	0.489	9.64	0.514
−159.36	0.227	− 93.86	0.309	−28.16	0.491	15.74	0.518
−136.36	0.256	− 85.46	0.322	−13.76	0.498	23.74	0.523

Heat of combustion	30° (c_v) 11379.8 cal 15°/g	**Jessup** (1937) (M. W. 128.243)
	30° (c_p) 11403.6 „	„
	25° (c_p) 11407.3 „	„

Iso-NONANES

2-METHYLOCTANE $(CH_3)_2CH-(CH_2)_5-CH_3$
3-METHYLOCTANE $CH_3-CH_2-CH\,(CH_3)-(CH_2)_4-CH_3$
4-METHYLOCTANE $CH_3-(CH_2)_2-CH\,(CH_3)-(CH_2)_3-CH_3$
2,5-DIMETHYLHEPTANE $(CH_3)_2CH-(CH_2)_2-CH(CH_3)-CH_2-CH_3$

Boiling point: **Wojciechowski** (1939)

2,6-DIMETHYLHEPTANE $CH_3-CH(CH_3)-(CH_2)_3-CH(CH_3)-CH_3$

Prepared hy bydrogenation of the 2,6-dimethylheptanol-1 obtained by the action of *iso*-butylmagnesium bromide on ethyl formate. White and Rose (1936) and White, Rose, Calingaert and Soroos (1939).

Constants

Boiling point

135°21	$\frac{dt}{dp}$ *(10 mm)*	0°49	Wojciechowski (1939)
135°21	,,	0°490	White and Rose (1936) and White, Rose, Calingaert and Soroos (1939)

Melting point

−102°95	White, Rose, Calingaert and Soroos (1939)
−103°25	White and Rose (1936)

Critical solution point in $C_6H_5NH_2$: 80°0 White, Rose, Calingaert and Soroos (1939)

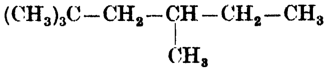
Density

t°	d	
20	0.70891	White, Rose, Calingaert and Soroos (1939)

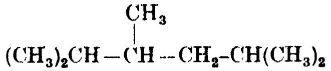
Refractive index

t°	D	
20	1.40073	White, Rose, Calingaert and Soroos (1939)
$\frac{dn}{dt}$	0.00049	,,

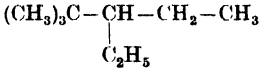
A. TRIMETHYLHEXANES

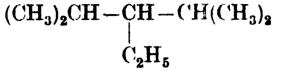
2,2,4- =

$(CH_3)_3C-CH_2-\underset{CH_3}{\underset{|}{CH}}-CH_2-CH_3$

2,2,5- = $(CH_3)_3C-CH_2-CH_2-CH(CH_3)_2$

2,3,5- =

$(CH_3)_2CH-\overset{CH_3}{\overset{|}{CH}}-CH_2-CH(CH_3)_2$

B. DIMETHYLETHYLPENTANES

2,2,3- =

$(CH_3)_3C-\underset{C_2H_5}{\underset{|}{CH}}-CH_2-CH_3$

2,4,3- =

$(CH_3)_2CH-\underset{C_2H_5}{\underset{|}{CH}}-CH(CH_3)_2$

	A			B	
	2,2,4-	2,2,5-	2,3,5-	2,2,3-	2,4,3-
Constants: HOWARD, MEARS, FOOKSON, POMERANTZ and BROOKS (1947)					
Boiling point	126°45	124°092	131°37	133°834	136°717
$\frac{dt}{dp}$ *(10 mm)*	0°503	0°485	0°492	0°506	0°504
Melting point	−123°4	−105°89	−127°9	−99°3	−122°4
Density 20°	0.71555	0.70711	0.72191	0.73478	0.73793
„ 25°	0.71178	0.70313	0.71792	0.73100	0.73415
Refractive index n_D					
20°	1.40328	1.39956	1.40601	1.41227	1.41371
25°	1.40095	1.39724	1.40365	1.41014	1.41146
$\frac{dn}{dt}$	0.00047	47	47	43	43
Heat of vaporisation 25° cal 15°/g	—	74.869	77.190	—	—
OSBORNE and GINNINGS (1947)					

TETRAETHYLMETHANE or 3,3-DIETHYLPENTANE $C(C_2H_5)_4$

Constants

Boiling point		*Freezing point*	
145°68	MATHOT (unp.)	31°6 33°110	MATHOT (unp.) STREIFF, MURPHY, CAHILL, FLANAGAN, SEDLAK, WILLINGHAM and ROSSINI (1947)

Density			*Viscosity*			*Surface tension*	
t°	d		t°	$\eta \cdot 10^5$		t°	γ
0	0.76757		15	863		15	24.44
15	0.75687		30	696		20	23.95
30	0.74610					30	22.76

Dielectric constant: 20° 1.998 PIETTE (unp.)

TETRAMETHYLPENTANES

$(CH_3)_3C-C(CH_3)_2-CH_2-CH_3$ (2,2,3,3-) (A)

$(CH_3)_3C-CH(CH_3)-CH(CH_3)_2$ (2,2,3,4-) (B)

$(CH_3)_3C-CH_2-C(CH_3)_3$ (2,2,4,4-) (C)

$(CH_3)_2CH-C(CH_3)_2-CH(CH_3)_2$ (2,3,3,4-) (D)

Constants: (I) STREIFF, MURPHY, CAHILL, FLANAGAN, SEDLAK, WILLINGHAM and ROSSINI (1946)

(II) HOWARD, MEARS, FOOKSON, POMERANTZ and BROOKS (1947)

(III) HOWARD (1940); (IV) SMITH (1941)

		(A)	(B)	(C)	(D)
Boiling point		140°264 (II)	133°010 (II)	122°281 (III) 122°283 (IV)	141°544 (II)
$\frac{dt}{dp}$ *(10 mm)*		0°512 „	0°501 „	0°492 (III)	0°514 „
Melting point		– 9°90 (I) –10°04 (II)	–121°09 (I) –122°2 (II)	–66°600 (III) –66°54 (I)	–102°14 (II) –102°123 (I)
Density	20°	0.75676 (II)	0.73915 (II)	0.71957 (III)	0.75489 (II)
	25°	0.75300 „	0.73537 „	0.71556 „	0.75112 „
Refractive index		n_D	n_D	n_D	n_D
	20°	1.42365 (II)	1.41462 (II)	1.40677 (III)	1.42222 (II)
	25°	1.42146 „	1.41242 „	1.40451 „	1.42005 „
	$\frac{dn}{dt}$	0.00044 „	0.00044 „	—	0.00043 „

Saturated vapour pressure of (C) $(CH_3)_3C{-}CH_2{-}C(CH_3)_3$

t°	p mm	t°	p mm	
58.356	99.52	102.438	433.56 (IV)	Smith (1941)
64.448	118.06	108.994	525.86 „	„
70.611	149.40	115.610	633.99 „	„
76.844	187.57	129.014	906.06 „	„
83.145	233.72	135.799	1074.58 „	„
89.511	289.13	142.638	1268.03 „	„
95.943	355.22	149.528	1489.4 „	„

n-DECANE n-$C_{10}H_{22}$

A number of physical constants that were given for *n*-decane do, in fact, correspond to di-*iso*-amyl.

Boiling point

173°95	Chavanne and Tock (1932)	174°02	Mair (1932)
174°0	Bruun and Hicks-Bruun (1932)	174°06	Shepard, Henne and Midgley (1931)

Freezing point

−29°673	Streiff, Murphy, Zimmerman, Soule, Sedlak, Willingham and Rossini (1947)	−29°76	Shepard, Henne and Midgley (1931)
		−30°	Huffman, Parks and Barmore (1931)
−29°68	Bruun and Hicks-Bruun (1932)		
−29°68	Mair (1932)		

Isotherms: Reamer, Olds, Sage and Lacey (1942)

Critical solution point

in $C_6H_5NH_2$	77°5	Shepard, Henne and Midgley (1931)
	77°6	Bruun and Hicks-Bruun (1932)

Density

t°	d		t°	d	
0	0.74487	Bruylants (unp.)	0	0.7448	Chavanne and Tock (1932)
15	0.73373	,,	20	0.7298	,,
20	0.72996	,,	20	0.73014	Shepard, Henne and Midgley (1931)
30	0.72238	,,	25	0.72643	,,
			20	0.72994	Bruun and Hicks-Bruun (1932)

Viscosity: 25° $852.7 \cdot 10^{-5}$ Shepard, Henne and Midgley (1931)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.41155	1.41185	1.41400	1.41414	1.41807	1.41908	1.42206	1.42315	Bruylants (unp.)
30	1.40529	1.40565	1.40768	1.40778	1.41131	1.41217	1.41568	1.41685	,,
$\frac{dn}{dt}$	0.00042	41	42	43	45	42	43	42	,,
20	—	1.40994	1.41203	—	—	1.41728	—	—	Shepard, Henne
25	—	1.40771	1.40986	—	—	1.41492	—	—	and Midgley
45.3	—	1.39831	1.40047	—	—	1.40549	—	—	,, (1931)
$\frac{dn}{dt}$	—	0.00043	43	—	—	47	—	—	,,
20	—	1.40999	1.41206	—	—	1.41715	—	1.42080	Vogel (1946)
25	—	—	1.40961	—	—	—	—	—	Mair (1932)
25	—	—	1.40960	—	—	—	—	—	Bruun and Hicks-Bruun (1932)

Specific heat: Huffman, Parks and Barmore (1931)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −181.86	0.188	−143.06	0.239	−92.96	0.297	L. −21.96	0.495
−176.36	0.196	−133.66	0.250	−82.56	0.310	−11.06	0.500
−170.96	0.204	−123.16	0.262	−72.96	0.323	+ 2.04	0.509
−166.16	0.210	−113.56	0.273	−62.66	0.338	8.14	0.512
−159.26	0.219	−103.06	0.285	−52.56		15.64	0.517
−152.46	0.228					24.54	0.523

Heat of melting	48.34 cal 15°/g	Huffman, Parks and Barmore (1931)
Heat of combustion	30° (c_v) 11355.2 ,,	Jessup (1937) (M. W. 142.2682)
	30° (c_p) 11378.6 ,,	,,
	25° (c_p) 11382.3 ,,	,,
	25° (c_p) 11387.2 ,,	Prosen and Rossini (1944) (M. W. 142.276)

BI-*iso*-AMYL or 2,7-DIMETYLOCTANE $(CH_3)_2CH-(CH_2)_4-CH(CH_3)_2$

Most of the values given for di-*iso*-amyl are unreliable owing to the presence of a small amount of the *iso*-amyl iodide or bromide used in the WÜRTZ synthesis. In order to eliminate these impurities, it is necessary to treat the hydrocarbon with concentrated sulphuric acid and this operation must be followed by fractional distillation.

Constants: TIMMERMANS and HENNAUT-ROLAND (1929)

Boiling point *Freezing point*

160°00	$\frac{dt}{dp}$ (10 mm) 0°50	—49°2	TIMMERMANS and HENNAUT-ROLAND (1929)
160°1	LECAT (passim)		

Density *Viscosity*

t°	d	t°	$\eta \cdot 10^5$
0	0.73785	15	889
15	0.72640	30	703
30	0.71494		

Surface tension

t°	γ	
15	22.78	TIMMERMANS and HENNAUT-ROLAND (1929), LEK (1930), HENNAUT-ROLAND and LEK (1931)
20	22.22	
30	21.14	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.
15	1.40787	1.40830	1.41049	1.41050	1.41447	1.41564	1.41853
$\frac{dn}{dt}$	0.00044	44	45	45	45	—	—

2-METHYLNONANE	$(CH_3)_2\,CH-(CH_2)_6-CH_3$	(A)
3- ,,	$CH_3-CH_2-CH(CH_3)-CH_2)_5-CH_3$	(B)
4- ,,	$CH_3-(CH_2)_2-CH(CH_3)-(CH_2)_4-CH_3$	(C)
5- ,,	$CH_3-(CH_2)_3-CH(CH_3)-(CH_2)_3-CH_3$	(D)

Constants: Calingaert and Soroos (1936) I and Parks, West and Moore (1941) II

		(A)	(B)	(C)	(D)	
Boiling point		166°8	167°8	—	165°1	(I)
Freezing point		−74°36	−84°66	98°46	−86°46	(II)
		−74°69	−84°86	—	−86°80	(I)
Density	20°	0.72805	0.73335	—	0.73225	(I)
Refractive index	$n_D^{20°}$	1.4099	1.4125	—	1.4122	(I)
Critical solution point in $C_6H_5NH_2$		80°3	78°25	—	77°9	(I)

Specific heat: II

(A)		(B)	(C)		(D)
t°	c_p	c_p	c_p	c_p	c_p
C. −193.16	0.1757	C. 0.1691	C. I 0.1732	C. II 0.1810	C. 0.1748
−183.16	0.1909	0.1848	0.1891	0.1991	0.1910
−173.16	0.2063	0.2000	0.2052	0.2175	0.2059
−163.16	0.2211	0.2146	0.2211	0.254	0.2202
−153.16	0.2350	0.2285	0.2349	0.427	0.2341
−143.16	0.2475	0.2425	0.2470	0.438	0.2479
−133.16	0.2600	0.2563	0.2598	0.438	0.2605
−123.16	0.2724	0.2688	0.2745	—	0.2730
−113.16	0.2848	0.2803	0.325	—	0.2862
−103.16	0.3020	0.2979			0.3075
− 93.16	0.343	0.340	L. 0.4440		0.360
− 83.16	0.464	L. 0.4426	0.4450		L. 0.4448
L. − 73.16	0.4680	0.4477	0.4510		0.4491
− 63.16	0.4688	0.4530	0.4570		0.4544
− 53.16	0.4705	0.4580	0.4630		0.4599
− 43.16	0.4738	0.4632	0.4690		0.4663
− 33.16	0.4782	0.4694	0.4758		0.4739
− 23.16	0.4849	0.4766	0.4844		0.4815
− 13.16	0.4922	0.4850	0.4938		0.4994
− 3.16	0.5003	0.4939	0.5029		0.5090
+ 6.84	0.5095	0.5030	0.5126		0.5187
16.84	0.5186	0.5119	0.5240		0.5282
26.84	0.5263	0.5190	0.5331		
Heat of melting cal 15°/g	29.38	31.41	25.51		27.95

(A) TETRAMETHYLHEXANES

2,2,3,3- = $(CH_3)_3C-C(CH_3)_2-(CH_2)_2-CH_3$
2,2,4,5- = $(CH_3)_3C-CH_2-CH(CH_3)-CH(CH_3)_2$
2,2,5,5- = $(CH_3)_3C-(CH_2)_2-C(CH_3)_3$

(B) PENTAMETHYLPENTANES

2,2,3,3,4- = $(CH_3)_3C-C(CH_3)_2-CH(CH_3)_2$
2,2,3,4,4- = $(CH_3)_3C-CH(CH_3)-C(CH_3)_3$

(C) DIMETHYL-*iso*-PROPYLPENTANE

2,4,3- = $(CH_3)_2CH-CH[CH(CH_3)_2]-$
$-CH(CH_3)_2$

Constants: Howard, Mears, Fookson, Pomerantz and Brooks (1947)

	(A)			(B)		(C)
	2,2,3,3-	2,2,4,5-	2,2,5,5-	2,2,3,3,4-	2,2,3,4,4-	2,4,3-
Boiling point	160°310	147°875	137°452	166°05	159°29	157°042
$\frac{dt}{dp}$ *(10 mm)*	0°538	0°512	0°500	0°552	0°537	0°544
Freezing point	−54°03		−12°64	−36°49	−38°81	−81°75
Density 20°	0.76450	0.73542	0.71875	0.78009	0.76702	0.75826
25°	0.76080	0.73165	0.71480	0.77675	0.76362	0.75460
Refractive index						
$n_D^{20°}$	1.42812	1.41321	1.40550	1.43606	1.43069	1.42465
$n_D^{25°}$	1.42606	1.41093	1.40315	1.43412	1.42868	1.42246
$\frac{dn}{dt}$	0.00041	46	47	39	40	44

n-UNDECANE n-$C_{11}H_{24}$

Constants

Boiling point: 195°84 Shepard, Henne and Midgley (1931)

Melting point

−25°61 −25°65	Mair (1932) Shepard, Henne and Midgley (1931)	−25°9	Huffman, Parks and Barmore (1931)

Transition point: —37°0 Huffman, Parks and Barmore (1931)

Critical solution point

in $C_6H_5NH_2$	80°6	Shepard, Henne and Midgley (1931)

Constants of state

Density

t°	d		t°	d	
0	0.75483	Bruylants (unp.)	20	0.74025	Shepard, Henne and Midgley
15	0.74390	„	25	0.73667	„ (1931)
30	0.73282	„			

Viscosity: 25° $1081 \cdot 10^{-5}$ Shepard, Henne and Midgley (1931)

Refractive index

t°	He r.	Hα	D	He y.	Heg.	Hβ	He v.	Hγ	
15	1.41688	1.41718	1.41922	1.41934	1.42343	1.42443	1.42747	1.42865	Bruylants (unp.)
30	1.41072	1.41106	1.41305	1.41322	1.41675	1.41822	1.42134	1.42235	„
$\frac{dn}{dt}$	0.00041	41	41	41	45	41	41	42	„
20	—	1.41514	1.41727	—	—	1.42252	—	—	Shepard, Henne
25	—	1.41300	1.41516	—	—	1.42036	—	—	and Midgley
45.3	—	1.40384	1.40611	—	—	1.41111	—	—	„ (1931)
$\frac{dn}{dt}$	—	0.00043	42	—	—	43	—	—	„
25	—	—	1.41495	—	—	—	—	—	Mair (1932)

Heat constants

Specific heat: Huffman, Parks and Barmore (1931)

t°	c_p	t°	c_p	t°	c_p
C. −181.16	0.188	−132.96	0.250	L. −14.66	0.503
−175.66	0.196	−115.06	0.271	+ 1.74	0.511
−160.76	0.215	− 83.06	0.310	10.26	0.515
				17.64	0.520
				24.84	0.524

Heat of transition	9.69 cal 15°/g	Huffman, Parks and Barmore
Heat of melting	34.12 „	„ (1931)
Heat of combustion	30° (c_v) 11331.0 „	Jessup (1937) (M. W. 156.2934)
	30° (c_p) 11354.7 „	„
	25° (c_p) 11358.4 „	„

n-DODECANE n-$C_{12}H_{26}$

Constants

Saturated vapour pressure: Willingham, Taylor, Pignocco and Rossini (1945)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
126.381	47.74	147.151	103.63	176.039	261.74	214.709	732.02
131.108	57.48	152.529	124.59	183.537	325.01	215.383	743.98
135.223	67.29	157.986	149.39	191.255	402.44	216.006	755.10
138.962	77.30	163.030	175.84	199.488	500.67	216.712	767.95
142.444	87.73	169.814	217.13	208.417	627.81	217.345	779.39

Boiling point

216°23	Shepard, Henne and Midgley (1931)	216°275	Willingham, Taylor, Pignocco and Rossini (1945)
216°26	Mair and Streiff (1940)		

Melting point

−9°6	Huffman, Parks and Barmore (1931)	−9°64	Ralston, Hoerr and Crews (1944)
−9°60	Mair and Streiff (1940)	−9°73	Shepard, Henne and Midgley (1931)
−9°604	Deanesly and Carleton (1941)		
−9°61	Mair (1932)		

Critical solution point in $C_6H_5NH_2$: 83°7 Shepard, Henne and Midgley (1931)

Density

t°	d		t°	d	
0	0.76327	Bruylants (unp.)	20	0.74876	Deanesly and Carleton (1941)
15	0.75248	„	25	0.74512	Mair and Streiff (1940)
30	0.74157	„			

Viscosity: 25° $1353 \cdot 10^{-5}$ Shepard, Henne and Midgley (1931)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.42136	1.42160	1.42371	1.42381	1.42795	—	1.43205	1.43325	Bruylants (unp.)
30	1.40536	1.41567	1.41753	1.41780	1.42154	—	1.42613	1.42713	„
$\frac{dn}{dt}$	0.00040	40	41	40	42		39	40	„
20	—	1.41936	1.42152	—	—	1.42673	—	—	Deanesly and Carleton (1941)
$\frac{dn}{dt}$	—	—	0.000404	—	—	—	—	—	
25	—	1.41736	1.41951	—	—	1.42469	—	—	Mair and Streiff (1940)

Specific heat: HUFFMAN, PARKS and BARMORE (1931)

t°	c_p	t°	c_p	t°	c_p
C. −179.86	0.184	−113.86	0.264	L. +1.94	0.510
−173.66	0.194	−102.16	0.277	9.74	0.514
−166.86	0.202	− 86.86	0.295	16.54	0.518
−159.46	0.212	− 75.56	0.309	24.54	0.521
−149.06	0.225	− 61.76	0.326		
−136.76	0.239	− 49.16	0.344		
−125.16	0.252				

Heat of melting	51.33 cal 15°/g	HUFFMAN, PARKS and BARMORE (1931)
Heat of combustion	19° (c_p) 11357.1 ,,	BANSE and PARKS (1933) (M.W. 170.21)
	25° (c_p) 11344.9 ,,	JESSUP (1937) (M.W. 170.3186)
	30° (c_p) 11341.2 ,,	,,
	30° (c_v) 11318.0 ,,	,,
	25° (c_p) 11347.1 ,,	PROSEN and ROSSINI (1944) (M.W. 170.328)

n-TRIDECANE n-$C_{13}H_{28}$

Constants: BRUYLANTS (unp.)

Boiling point: 234°0 LECAT (passim)

Density

t°	d	
0	0.77049	BRUYLANTS (unp.)
15	0.75986	,,
30	0.74915	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.42516	1.42544	1.42756	1.42766	1.43195	1.43293	1.43599	1.43724	BRUYLANTS (unp.)
30	1.41920	1.41952	1.42160	1.42173	1.42550	1.42687	1.43032	1.43109	,,
$\frac{dn}{dt}$	0.00039	39	39	39	42	40	37	41	,,

n-TETRADECANE $n\text{-}C_{14}H_{30}$

Constants

Freezing point

5°5	PARKS and LIGHT (1934)	5°6	VAN HOOK and SILVER (1942)

Density

t°	d		t°	d	
15	0.76632	BRUYLANTS (unp.)	20	0.7624	VOGEL (1946)
30	0.75559	,,	40.6	0.7494	,,
			61.5	0.7348	,,
			86.3	0.7175	,,

Surface tension

t°	γ	t°	γ	
21.5	26.53	60.2	23.15	VOGEL (1946)
25.2	26.16	87.8	20.84	,,
40.9	24.90			,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.42845	1.42882	1.43092	1.43097	1.43523	1.43628	1.43941	1.44064	BRUYLANTS (unp.)
30	1.42260	1.42297	1.42501	1.42515	1.42895	1.43033	1.43364	1.43468	,,
$\frac{dn}{dt}$	0.00039	39	39	39	42	39	38	39	,,
20	—	1.42688	1.42907	—	—	1.43433	—	1.43818	VOGEL (1946)
20	—	—	1.4290	—	—	—	—	—	VAN HOOK and SILVER (1942)
$\frac{dn}{dt}$	—	—	0.000410	—	—	—	—	—	

Specific heat: PARKS and LIGHT (1934)

t°	c_p	t°	c_p	t°	c_p
C. −179.86	0.180	−122.06	0.250	−50.36	0.337
−174.36	0.188	−109.16	0.263	−41.76	0.348
−167.86	0.196	−98.36	0.277	−37.36	0.357
−163.76	0.201	−88.76	0.292	L. + 7.44	0.517
−152.06	0.216	−72.26	0.311	11.24	0.520
−139.96	0.230	−68.66	0.312	13.14	0.521
−133.76	0.238	−59.56	0.323	17.44	0.523

n-PENTADECANE $n\text{-}C_{15}H_{32}$

Constants: Bruylants (unp.)

Freezing point: 10° Krafft (1882)

Density

t°	d		t°	d	
15	0.77197	Bruylants (unp.)	20	0.7687	Vogel (1946)
30	0.76146	„	41.0	0.7549	„
			61.4	0.7412	„
			86.7	0.7236	„

Surface tension

t°	γ	t°	γ	
22.6	26.97	62.0	23.57	Vogel (1946)
40.9	25.43	86.0	21.65	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.43143	1.43171	1.43389	1.43394	1.43824	1.43930	1.44245	1.44361	Bruylants
30	1.42572	1.42608	1.42812	1.42828	1.43205	1.43345	1.43668	1.43787	„ (unp.)
$\frac{dn}{dt}$	0.00038	39	38	38	41	39	38	38	„
20	—	1.42980	1.43199	—	—	1.43734	—	1.44126	Vogel (1946)

n-HEXADECANE $n\text{-}C_{16}H_{34}$

Constants

Saturated vapour pressure

t°	p mm		t°	p mm	
137	5.3	Francis and Wood (1926)	156	13.8	Francis and Wood (1926)
145	9.0	„	161.5	19.5	„

Freezing point

18°11	Smith (1932)	18°18	Ralston, Hoerr and Crews (1944)
18°13	Carey and Smith (1933)	18°25	Krafft (1886)
18°145	Deanesly and Carleton (1941)		

Density

t°	d	
20	0.77335	**Deanesly** and **Carleton** (1941)
25.03	0.76991	„
30	0.76667	**Bruylants** (unp.)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
20	—	1.43214	1.43435	—	—	1.43976	—	—	**Deanesly** and **Carleton** (1941)
25.03	—	1.43024	1.43247	—	—	1.43784	—	—	
$\frac{dn}{dt}$	—	0.00038	38	—	—	38	—	—	„
30	1.42834	1.42869	1.43084	1.43100	1.43479	1.43618	1.43957	1.44056	**Bruylants** (unp.)

n-HEPTADECANE $n\text{-}C_{17}H_{36}$

Constants

Melting point: 21°72 **Ralston**, **Hoerr** and **Crews** (1944)

Density: 30° 0.77100 **Bruylants** (unp.)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
30	1.43060	1.43092	1.43316	1.43325	1.43718	1.43844	1.44179	1.44275	**Bruylants** (unp.)

n-OCTADECANE $n\text{-}C_{18}H_{38}$

Ubbelohde (1938) has carefully purified this product by molecular distillation.

Melting point and *heat of melting* **Oldham** and **Ubbelohde** (1940)

Heat of combustion **Parks**, **West**, **Naylor**, **Fujii** and **MacClaine** (1946)

Higher paraffins were prepared by **Krafft** (1882—86) and **Eykman** (1896—1919)

Nederbragt and **Boelhouwer** (1947) measured the densities and the viscosities of normal hydrocarbons in C_{24}, C_{35}, C_{43}; 2,2-dimethyldocosane (C_{24}); 10-nonylnonadecane (C_{28}); 7,12-dimethyl-9,10-di-*n*-hexyloctadecane (C_{32}).

Mazee (1948) has made a complete survey of normal hydrocarbons from C_{21} to C_{43} and of a series of their isomers.

EICOSANE $n\text{-}C_{20}H_{42}$

Melting point KRAFFT (1882)
Melting point, heat of melting and *specific heat* PARKS, HUFFMAN and THOMAS (1930)
Refractive index EYKMAN (1896)

DOCOSANE $n\text{-}C_{22}H_{46}$

Melting point KRAFFT (1882)
Saturated vapour pressure FRANCIS and WOOD (1926)

TRICOSANE $n\text{-}C_{23}H_{48}$

Constants MAZEE (1948)
Melting point KRAFFT (1882)
Refractive index EYKMAN (1919)

DOTRIACONTANE $n\text{-}C_{32}H_{66}$

Prepared from cetyl alcohol.

SEYER and MORRIS (1939) think that the presence of higher hydrocarbons raises the melting point.

Constants

Melting point

69°65	SEYER and MORRIS (1939)	70°16	RALSTON, HOERR and CREWS (1944)
70°0	DELCOURT (1931) and DEFFET (1935)	70°2	HILDEBRAND and WACHTER (1929)

Transition point

63°5	SEYER and MORRIS (1939)	64°3	DEFFET (1935)

Melting curve		*Transition curve*		
t°	p kg/cm²	t°	p kg/cm²	
70.00	1	64.3	1	DEFFET (1935)
75.00	230	70.00	253	,,
80.00	455	75.00	474	,,
84.90	656	80.00	698	,,
89.80	870	85.00	922	,,
93.30	1015			,,

Density and viscosity

t°	d	$\eta \cdot 10^5$	
75	0.77910	658	DELCOURT (1931)
100	0.76321	409	,,
118	0.75185	—	,,

Heat of combustion	25° (c_p) 11161.8 cal 15°/g	PARKS, WEST, NAYLOR, FIJII and MACCLAINE (1946) (M. W. 450.848)

B. ETHYLENIC HYDROCARBONS

These compounds have been studied far less than the saturated paraffins.

ETHYLENE C_2H_4

Preparation in the pure state: By catalytic dehydration of the vapour of ethanol over calcined Al_2O_3 or by the action of concentrated sulphuric or phosphoric acid on ethyl alcohol (yields a less pure product) Batuecas (1925).

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. atm.	
9.50	50.65	Cardoso (1912)
9.25	50.02	Kay (1948)

Densities of the liquid and the saturated vapour

t°	L.	V.	t°	L.	V.	
−145.07	0.62465	—	−19.20	0.41313	0.051138	Mathias, Crommelin and
−129.90	0.60449	—	−14.18	0.39855	0.059942	Watts (1927)
−114.69	0.58380	—	−10.93	0.38818	0.067215	„
−103.01	0.56740	—	− 7.70	0.37721	0.076050	„
− 63.41	0.50588	0.012584	+ 5.84	0.30840	0.13266	„
− 48.15	0.47822	0.020407	6.50	0.30342	0.13716	„
− 37.13	0.45610	0.029465	7.98	0.28726	0.15268	„
− 24.33	0.42655	0.041854				„

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−149.690	15.78	−127.611	143.65	−108.036	586.44	Egan and Kemp (1937)
−144.605	28.38	−122.148	221.75	−105.398	685.00	„
−137.232	60.67	−116.990	323.74	−102.801	803.37	„
−132.215	90.56	−111.530	469.37			„
−141.46	39.3	−121.02	241.5	—	—	Henning and Stock (1921)
−130.06	116.6	−110.33	508.2	—	—	„
−125.27	174.0	−110.03	523.4	−102.99	794.7	Kistiakowsky, Romeyn Jr., Ruhoff, Smith and Vaughan (1935)
−118.24	296.2	−104.85	714.4	− 99.91	948.8	

t°	p atm.	t°	p atm	t°	p atm.	
− 69.27	5.259	− 30.53	188.51	−7.54	33.923	Crommelin and Watts
− 60.90	7.206	− 20.01	24.905	0.00	40.276	„ (1927)
− 52.09	9.774	− 10.01	31.971	+7.90	48.162	„
− 41.01	13.907					„

Boiling point

−103°7 −103°7	Stock (1923) Egan and Kemp (1937)	−103°72 −103°9	Henning and Stock (1921) Burrell and Robertson (1915)

Melting point

−169°5	Eucken and Hauck (1928)	−169°50	Kistiakowsky, Romeyn Jr., etc. (1935)

Triple point

−169°19 /0.001 atm.	Clusius and Weigand (1940)

Melting curve: Clusius and Weigand (1940)

t°	p atm.	t°	p atm.	t°	p atm.
−169.19	0.001	−168.52	47.1	−167.96	85.5
−169.07	8.6	−168.37	57.2	−167.86	93.15
−168.94	17.4	−168.23	66.8	−167.85	93.5
−168.81	26.8	−168.11	75.9	−167.84	94.9
−168.66	36.8				

Isotherms

From 1° to 20°; from 23 to 33 atm. Crommelin and Watts (1927)
From 0° to 150°; from 16 to 290 atm. Michels, Degruyter and Niesen (1936)
From 0° to 150°; until 3000 atm. Michels and Geldermans (1942)
In the critical region: Maass and Geddes (1936) and Dacey, Mac Intosh and Maass (1939).

Weight of the normal litre in the gaseous state

1.2603 Batuecas (1918)
1.26026 Stock and Ritter (1927) (corr. 1.26057, Stock and Ritter (1926)
1.26036 Moles, Toral and Escribano (1938)
$\mathrm{L.}_p = (1.25122 \pm 0.000003) + 0.0091333\,p$,,

Molecular weight in the gaseous state

28.0556 Cawood and Patterson (1936)

Coefficient of expansion

from 25° to 50° at 760 mm: $3735 \cdot 10^{-6}$ Coppock and Whytlaw-Gray (1934)

Coefficient of compressibility

from 0 to 1 atm. at 0°: $1 + \lambda = 1.00780$ Batuecas (1925)

Heat constants

Specific heat: Rossini and Knowlton (1937)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −257.16	0.0286	−225.87	0.2473	L. −166.47	0.5890	−121.28	0.5736
−254.35	0.04634	−220.64	0.2786	−164.58	0.5883	−114.61	0.5719
−251.25	0.06853	−215.56	0.3067	−160.88	0.5861	−108.93	0.5722
−247.99	0.09118	−210.36	0.3310	−154.13	0.5826	−104.45	0.5740
−244.06	0.1199	−204.75	0.3560	−147.26	0.5808		
−240.00	0.1530	−198.46	0.3849	−140.56	0.5783		
−235.81	0.1850			−133.08	0.5747		
−230.09	0.2156			−127.78	0.5740		

Heat of combustion	25° (c_p) 12023.7 cal 15°/g	Rossini and Knolwton (1937) (M. W. 28.0512)

Other thermodynamic properties

Michels, Geldermans and De Groot (1946) and Michels, De Groot and Geldermans (1947)

PROPENE $CH_2{=}CH{-}CH_3$

Constants

Critical constants

t° cr.	p cr. atm.	d cr.	
91.4	45.4	0.233	Vaughan and Graves (1940)
91.76	45.61	0.247	Marchman, Prengle Jr. and Motard(1949)

Saturated vapour pressure

t°	p mm	t°	p mm	
−47.135	779.92	−83.709	103.54	Powell and Giauque (1939)
−52.932	598.30	−88.674	73.19	„
−59.817	425.47	−93.209	52.32	„
−65.765	309.96	−96.695	39.92	„
−70.493	237.31	−100.439	29.41	„
−77.577	154.52	−107.396	15.98	„
−37.73	1164.2	−60.65	404.6	Lamb and Roper (1940)
−45.58	834.2	−74.69	183.4	„
−50.64	662.8	−88.08	75.75	„

t°	p atm.	t°	p atm.	t°	p atm.	
29.0	12.8	32.3	13.9	37.3	15.6	FRANCIS and ROBBINS
29.1	12.9	35.2	14.9	39.1	16.4	„ (1933)
30.2	13.3	35.9	15.1	42.3	17.5	„
31.4	13.5	36.0	15.2	44.0	18.2	„
				45.8	18.8	„

Densities of the liquid and the saturated vapour

t°	p atm.	L.	V.	
0	5.75	0.590	0.0123	VAUGHAN and GRAVES (1940)
25	11.38	0.537	0.0246	„
50	20.28	0.478	0.0458	„
75	33.50	0.397	0.0890	„
90	44.18	0.294	0.174	„
91	45.08	0.277	0.189	„
91.4	45.4	0.233	0.233	„

Boiling point

—47°67/759.1 mm	ASHDOWN, HARRIS and ARMSTRONG (1936)
—47°75	POWELL and GIAUQUE (1939)
—47°91/755 mm	KISTIAKOWSKY, RUHOFF, SMITH and VAUGHAN (1935)

Melting point

—184°9	HUFFMAN, PARKS and BARMORE (1931)
—185°25	POWELL and GIAUQUE (1939)

Weight of the litre in the gaseous state

0°/760 mm	1.9149	BATUECAS (1934)
0°/506.67 mm	1.9021	„
0°/380 mm	1.8956	„
25°/760 mm	1.7461	POWELL and GIAUQUE (1939)

Isotherms: from 10 to 215 atm and from 30° to 250° MARCHMAN, PRENGLE JR. and MOTARD (1949)

Specific heat: Powell and Giauque (1939)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −258.98	0.0271	−222.50	0.207	L. −179.25	0.524	−104.15	0.497
−256.50	0.0378	−217.20	0.224	−174.50	0.518	− 96.45	0.499
−253.53	0.0526	−211.91	0.244	−168.98	0.511	− 85.39	0.501
−250.35	0.0725	−206.55	0.261	−163.28	0.508	− 78.50	0.504
−246.93	0.0926	−201.71	0.276	−157.52	0.503	− 71.39	0.510
−243.29	0.112	−196.67	0.292	−145.07	0.499	− 63.98	0.513
−239.54	0.133	−196.57	0.295	−138.60	0.498	− 56.75	0.514
−235.70	0.153	−191.47	0.319	−131.95	0.495	− 49.76	0.520
−231.87	0.171	−188.29	0.339	−118.19	0.496		
−227.63	0.187	−186.99	0.383	−111.28	0.496		

Powell's sample seems pure but the curve $c_p/t°$ is rather irregular.

Heat of vaporisation	(B.P.) 104.69 cal 15°/g	Powell and Giauque (1939)
Heat of melting	16.67 „	Huffman, Parks and Barmore (1931)
	17.06 „	Powell and Giauque (1939)
Heat of combustion	25° (c_p) 11688.6 „	Rossini and Knowlton (1937) (M. W. 42.0768)

BUTENE-1 $CH_2{=}CH{-}CH_2{-}CH_3$

Prepared by dehydration of *normal* butyl alcohol by means of activated alumina.

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	
−56.75	64.12	−7.47	727.5	Lamb and Roper (1940)
−25.30	340.7	−0.67	941.7	„
−22.91	378.3	0	964.1	„
−10.60	641.4			„

Boiling point: −6°1 Grosse (1937)
−6°37 Kistiakowsky, Ruhoff, Smith and Vaughan (1935)

Specific heat: Todd and Parks (1936)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
L. −191.86	0.4736	−155.16	0.4521	−97.46	0.4572	−49.96	0.4827
−186.36	0.4684	−138.66	0.4505	−91.26	0.4590	−44.16	0.4864
−180.36	0.4634	−130.66	0.4505	−85.16	0.4621	−38.36	0.4923
−176.46	0.4607	−124.16	0.4514	−77.36	0.4670	−32.56	0.4959
−170.96	0.4575	−117.76	0.4522	−71.16	0.4706	−25.36	0.5016
−164.56	0.4558	−109.86	0.4539	−55.96	0.4788	−19.76	0.5076

BUTENES-2 $CH_3-CH=CH-CH_3$

The butenes-2 are prepared by dehydration, with concentrated sulphuric acid, of *secondary* butyl alcohol. They are purified by fractional distillation.

Cis-BUTENE-2

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−86.90	3.71	−14.66	361.2			Lamb and Roper (1940)
−53.21	45.44	−13.79	373.7			,,
−47.49	64.73	0	658.3			,,
−43.05	83.79	+ 2.87	749.7			,,
−33.65	141.2	9.60	951.5			,,
−78.14	5.70	0.01	658.90			Kistiakowsky, Ruhoff,
−47.21	64.65	24.38	1572.90			Smith and Vaughan
−21.04	265.45					,, (1935)
−70.090	13.09	−23.129	240.04	6.702	850.50	Scott, Ferguson and
−62.548	23.15	−14.822	353.25	11.144	1000.27	Brickwedde (1944)
−55.370	38.29	− 6.716	501.46	15.520	1167.07	,,
−48.117	61.12	− 6.706	501.51	19.855	1354.53	,,
−40.075	98.58	+ 0.56	672.53	22.759	1489.85	,,
−31.547	157.18	3.689	759.14			,,

Boiling point

3°21	Lamb and Roper (1940)	3°73	Kistiakowsky, Ruhoff, Smith and Vaughan (1935)
3°717	Scott, Ferguson and Brickwedde (1944)		

Melting point

—138°910	Glasgow Jr., Krouskop, Beadle, Axilbrod and Rossini (1948)	—139°3	Kistiakowsky, Ruhoff, Smith and Vaughan (1935)
		—139°36	Todd and Parks (1936)

Triple point

—138°900	Scott, Ferguson and Brickwedde (1944)

Specific heat

t°	c_p	t°	c_p	
C. —179.56	0.2613	—99.16	0.4711	Todd and Parks
—174.46	0.2722	—93.16	0.4704	„ (1936)
—172.66	0.2747	—80.96	0.4717	„
—166.16	0.2887	—74.96	0.4731	„
—162.96	0.2930	—61.96	0.4756	„
—159.36	0.3011	—54.96	0.4782	„
—156.66	0.3064	—48.56	0.4800	„
—150.96	0.3168	—42.16	0.4828	„
L. —134.96	0.4803	—29.66	0.4895	„
—128.16	0.4766	—23.56	0.4932	„
—120.36	0.4737	—17.86	0.4970	„
—111.36	0.4716	—12.16	0.5021	„
—105.36	0.4711	— 6.56	0.5064	„
C. —268.16	0.000509	—103.16	0.47427	Scott, Ferguson and Brickwedde (1944) (M. W. 56.104)
—263.16	0.004071	—93.16	0.47333	
—253.16	0.02857	—83.16	0.47372	„
—243.16	0.06722	—73.16	0.47491	„
—233.16	0.10747	—63.16	0.47690	„
—223.16	0.14371	—53.16	0.48003	„
—213.16	0.17618	—43.16	0.48440	„
—203.16	0.20441	—33.16	0.48966	„
—193.16	0.22953	—23.16	0.49556	
—183.16	0.25301	—13.16	0.50243	(Values at other temperatures: see authors)
—173.16	0.27447	— 3.16	0.51031	
—163.16	0.29520	+ 1.84	0.51464	„
—153.16	0.31642	11.84	0.52380	„
—143.16	0.33858	21.84	0.53391	„
L. —123.16	0.47893	25.00	0.53737	„
—113.16	0.47625	26.84	0.53938	„

Heat of vaporisation	t°	cal 15°/g	t°	cal 15°/g	
	−26.98	106.13	−0.80	100.42	SCOTT, FERGUSON and BRICKWEDDE (1944)
	−20.72	105.07	+6.54	98.841	
	− 9.87	102.54	19.09	95.750	„

Heat of melting			
	31.17	cal 15°/g	TODD and PARKS (1936)
	32.2969	„	SCOTT, FERGUSON and BRICKWEDDE (1944)

Trans-BUTENE-2

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−68.40	18.46	−33.65	163.7	−6.96	559.5	LAMP and ROPER (1940)
−53.21	53.45	−22.23	287.4	0	733.7	„
−47.49	75.78	−14.66	403.1	2.87	820.2	„
−43.05	97.94	−13.79	419.9	9.60	1047.9	„
						„
−77.96	8.75	−21.05	302.30	+20.56	1521.65	KISTIAKOWSKI, RUHOFF,
−47.20	76.60	+ 0.01	733.75	24.53	1729.30	SMITH and VAUGHAN
−46.89	78.05	19.94	1400.65	—	—	„ (1935)
−71.457	14.92	−37.359	134.51	−9.958	492.86	GUTTMAN and PITZER
−60.543	32.76	−28.303	214.37	−3.827	630.38	„ (1945)
−51.018	60.64	−21.001	303.58	+0.982	762.97	„
−42.899	98.83	−14.259	410.47			„

Boiling point

0°884	GUTTMAN and PITZER (1945)
0°96	KISTIAKOWSKY, RUHOFF, SMITH and VAUGHAN (1935)

Melting point

− 105°55	GUTTMAN and PITZER (1945)	−105°8	KISTIAKOWSKY, RUHOFF, SMITH and VAUGHAN (1935)
− 105°550	GLASGOW Jr., KROUSKOP, BEADLE, AXILBROD and ROSSINI (1948)		

Specific heat: Todd and Parks (1936)

t°	c_p	t°	c_p
C. −179.56	0.2462	L. −97.16	0.4703
−174.06	0.2592	−90.66	0.4722
−167.46	0.2741	−57.46	0.4883
−147.26	0.3225	−51.36	0.4920
−138.96	0.3433	−19.56	0.5141
		−13.56	0.5199

Iso-BUTENE or 2-METHYLPROPENE-1 $CH_2{=}C(CH_3)_2$

The *iso*-butene is obtained very pure by dehydration of *tertiary* butylalcohol and fractionation of the product.

Constants

Critical constants

t° cr.	p cr atm.	d cr.	
144°73	39.48	0.234	Beattie, Ingersoll and Stockmayer (1942)

Saturated vapour pressure

t°	p atm.		t°	p mm	
30	3.444	Beattie, Ingersoll and Stockmayer (1942)	−56.75	65.44	Lamb and Roper (1940)
50	5.976		−25.30	357.8	,,
75	10.86	,,	−20.88	431.0	,,
100	18.08	,,	− 7.47	748.5	,,
125	28.41	,,	− 0.67	966.0	,,
		,,	0	987.8	,,

Boiling point

−6°6	Grosse (1937)	−7°0	Lamb and Roper (1940)
−7°0	Kistiakowsky, Ruhoff, Smith and Vaughan (1935)		

Melting point

—140°350	Glasgow Jr., Krouskop, Beadle, Axilbrod and Rossini (1948)	−140°7	Kistiakowsky, Ruhoff, Smith and Vaughan (1935)
		−140°7	Todd and Parks (1936)

Isotherms in the critical region: Beattie, Ingersoll and Stockmayer (1942)

Specific heat: Todd and Parks (1936)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −179.86	0.2498	L. −133.96	0.4547	−100.26	0.4650	−45.26	0.4970
−174.36	0.2614	−127.96	0.4564	− 93.36	0.4681	−34.16	0.5037
−167.66	0.2749	−121.16	0.4579	− 86.66	0.4715	−30.46	0.5089
−160.86	0.2898	−114.06	0.4600	− 62.92	0.4860	−25.16	0.5133
−154.26	0.3056	−107.06	0.4621	− 56.96	0.4896	−20.06	0.5173

Heat of melting	25.25 cal 15°/g	Todd and Parks (1936)

PENTENE-1 $CH_2{=}CH{-}CH_2{-}CH_2{-}CH_3$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−0.159	233.72	24.834	633.99	45.614	1268.0	Scott, Waddington, Smith and Huffman (1949)
+4.751	289.13	29.967	760.00	50.914	1489.1	
9.706	355.22	35.142	906.06	56.253	1740.8	
14.704	433.56	40.359	1074.6	61.641	2026.0	,,
19.750	525.86					,,

Boiling point

29°9	Kazanskii, Liberman, Plate, Rosengart and Tarassova (1947)	29°967	Scott, Waddington, Smith and Huffman (1949)
		30°08	Geldof and Wibaut (1948)

Melting point: −166°222 Todd, Oliver and Huffman (1947)

Density

t°	d	
15	0.6458	Wibaut and Geldof (1946)
20	0.6406	,,
20	0.6411	Kazanskii, Liberman, etc. (1947)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He (4713)	He v.	Hγ	
15	1.3721	1.3725	1.3748	1.3748	1.3795	1.3806	1.3819	1.3842	1.3856	WIBAUT and GELDOF
20	1.3690	1.3694	1.3716	1.3717	1.3763	1.3774	1.3787	1.3810	1.3823	„ (1946)
$\frac{dn}{dt}$	0.0006	6	6	6	6	6	6	6	7	„
20	—	—	1.3719	—	—	—	—	—	—	KAZANSKII, etc. (1947)

Specific heat: TODD, OLIVER and HUFFMAN (1947) (M.W. 70.130)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −260.44	0.012	−231.38	0.118	L. −138.04	0.4386	−52.69	0.4661
−258.63	0.0170	−225.06	0.137	−127.96	0.4396	−44.72	0.4705
−257.86	0.0194	−218.51	0.1551	−117.99	0.4409	−43.65	0.4718
−256.49	0.0238	−212.10	0.1706	−108.12	0.4426	−34.65	0.4773
−253.94	0.0327	−211.30	0.1723	− 98.36	0.4453	−33.90	0.4782
−253.88	0.0332	−205.22	0.1855	− 88.69	0.4483	−28.76	0.4816
−250.29	0.0474	−204.77	0.1867	− 78.18	0.4528	−23.26	0.4859
−249.17	0.0521	−197.69	0.2029	− 71.19	0.4557	−18.34	0.4898
−246.21	0.0639	−189.88	0.2176	− 66.87	0.4577	− 8.07	0.4982
−243.48	0.0743	−181.60	0.2330	− 61.84	0.4605	+ 2.02	0.5069
−242.01	0.0803			− 55.61	0.4639	11.95	0.5166
−237.50	0.0972					22.12	0.5262

Heat of melting	19.81 cal 15°/g	TODD, OLIVER and HUFFMAN (1947)

Cis-PENTENE-2 $CH_3-CH=CH-CH_2-CH_3$

Constants: TODD, OLIVER and HUFFMAN (1947)

Melting point: −151°359

Specific heat: (M.W 70.130).

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −259.65	0.0117	−170.26	0.25791	− 85.60	0.4492	−13.10	0.4845
−249.60	0.04322	−162.23	0.27551	− 74.88	0.4518	− 1.15	0.4939
−230.86	0.11[illegible]6	−156.81	0.29506	− 64.26	0.4549	+ 5.55	0.4993
−218.07	0.15070	L. −144.47	0.4544	− 53.76	0.4595	8.77	0.5020
−209.49	0.17360	−129.86	0.4499	− 43.41	0.4642	13.49	0.5063
−198.93	0.19828	−119.54	0.4485	− 33.16	0.4702	15.43	0.5085
−191.95	0.21390	−109.50	0.4474	− 23.05	0.4772	22.11	0.5144
−181.36	0.23593	− 96.40	0.4480	(Values at other temperatures: see authors)			

Heat of melting *Heat of combustion*	24.254 cal 15°/g 25° (c_p) 11366.9 „	TODD, OLIVER and HUFFMAN (1947) COOPS, MULDER, DIENSKE and SMITTENBERG (1946) (M. W. 70.130)

Trans-PENTENE-2 $CH_3-CH{=}CH-CH_2-CH_3$

Constants: TODD, OLIVER and HUFFMAN (1947)

Freezing point

−140°248	STREIFF, MURPHY, SEDLAK, WILLINGHAM and ROSSINI (1946)
−140°21	TODD, OLIVER and HUFFMAN (1947)

Specific heat: (M.W. 70.130)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −260.39	0.00875	−215.01	0.15203	L. −138.18	0.43493	−68.69	0.46172
−258.37	0.0134	−213.08	0.15691	−132.57	0.43647	−65.02	0.46399
−256.45	0.01855	−208.91	0.16811	−129.70	0.43734	−53.91	0.47019
−254.71	0.02399	−201.31	0.18620	−120.89	0.43961	−42.93	0.47742
−251.48	0.03466	−195.12	0.19994	−118.21	0.44078	−32.35	0.48489
−248.64	0.04475	−191.49	0.20731	−115.07	0.44140	−21.51	0.49335
−247.52	0.04859	−189.00	0.21336	−108.26	0.44366	−11.08	0.50181
−242.70	0.06575	−184.11	0.22335	−103.21	0.44569	− 0.85	0.51116
−237.59	0.08400	−176.24	0.23804	− 98.44	0.44715	+ 7.36	0.51824
−232.26	0.10172	−167.99	0.25259	− 91.54	0.45033	9.31	0.51920
−226.50	0.1197	−159.46	0.26745	− 87.78	0.45187	15.58	0.52580
−220.76	0.1364			− 80.03	0.45548	22.90	0.53290
−218.46	0.14273			− 76.32	0.45786	28.52	0.53849

Heat of melting *Heat of combustion*	28.483 cal 15°/g 25° (c_p) 11364.3 „	TODD, OLIVER and HUFFMAN (1947) COOPS, MULDER, DIENSKE and SMITTENBERG (1946) (M. W. 70.130)

2-METHYLBUTENE-1 $CH_2{=}C(CH_3){-}CH_2{-}CH_3$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
1.155	233.72	26.062	633.99	46.728	54.399	SCOTT, WADDINGTON, SMITH and HUFFMAN (1949)
6.054	289.13	31.162	760.00	52.005	59.753	
10.993	355.22	36.308	906.06	57.320	65.151	
15.973	433.56	41.500	1074.6	62.675	70.590	
20.996	525.86					

Boiling point: 31°162 SCOTT, WADDINGTON, SMITH and HUFFMAN (1949)

Freezing point

−137°54	TODD, OLIVER and HUFFMAN (1947)
−137°582	STREIFF, MURPHY, SEDLAK, WILLINGHAM and ROSSINI (1946)

Specific heat: TODD, OLIVER and HUFFMAN (1947) (M.W. 70.130)

t°	c_p	t°	c_p	t°	c_p	t°	c_p.
C. −260.47	0.0118	−229.64	0.1167	−182.10	0.22218	−86.76	0.46052
−258.70	0.01682	−225.44	0.1278	−178.32	0.22849	−75.87	0.46461
−256.66	0.02362	−218.77	0.14412	−174.53	0.23427	−65.11	0.46930
−254.12	0.03289	−217.34	0.14744	−166.45	0.24130	−54.49	0.47455
−253.90	0.03410	−214.72	0.15969	−163.13	0.24686	−44.01	0.48064
−250.70	0.04613	−211.85	0.16831	−155.63	0.26445	−33.67	0.48712
−246.39	0.06257	−207.77	0.17410	L. −129.25	0.45347	−23.48	0.49438
—243.93	0.07140	−204.83	0.18392	−125.04	0.45377	−13.44	0.50198
—242.10	0.07764	−199.74	0.18842	−112.21	0.45487	− 2.75	0.51095
−238.01	0.09179	−197.31	0.20298	−108.94	0.45509	+ 8.58	0.52055
−231.85	0.1106	−189.62	0.21122	− 98.72	0.45705	19.70	0.53075

(Values at other temperatures: see authors)

Heat of melting: 26.978 cal 15°/g TODD, OLIVER and HUFFMAN (1947)

3-METHYLBUTENE-1 or *Iso*-PROPYLETHYLENE $CH_2{=}CH{-}CH(CH_3)_2$

Constants: TODD, OLIVER and HUFFMAN (1947)

Melting point: −168°44

Specific heat: (M.W. 70.130)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −258.24	0.01829	−217.44	0.14499	−147.74	0.41607	−37.06	0.47345
−256.20	0.02473	−212.66	0.15546	−139.50	0.41817	−26.41	0.48254
−254.12	0.03191	−204.71	0.17184	−130.33	0.42092	−15.94	0.49117
−250.00	0.04718	−203.85	0.17361	−120.09	0.42451	− 6.50	0.49922
−246.01	0.06203	−196.54	0.18756	−110.00	0.42842	+ 0.32	0.50581
−243.66	0.07040	−195.84	0.18882	−100.06	0.43340	7.87	0.51325
−241.66	0.07740	−188.28	0.20350	− 89.78	0.43831	16.61	0.52274
−237.34	0.09191	−187.07	0.20547	− 79.18	0.44489	25.19	0.53209
−230.92	0.1112	−180.77	0.21650	−68.64	0.45037	(Values at other temperatures: see authors)	
−224.30	0.1288	−173.74	0.22928	−58.46	0.45735		
−218.98	0.1415	L. −155.21	0.41460	−47.89	0.46519		

Heat of melting: 18.278 cal 15°/g

2-METHYLBUTENE-2 $CH_3-C(CH_3)=CH-CH_3$

Constants

Saturated vapour pressure: Scott, Waddington, Smith and Huffman (1949)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
3.042	187.57	23.103	433.56	43.806	906.06	59.753	1489.1
8.008	233.72	28.220	525.86	49.078	1074.6	65.151	1740.8
12.987	289.13	33.373	633.99	54.399	1268.0	70.590	2026.0
18.033	355.22	38.567	760.00				

Boiling point: 38°567 Scott, Waddington, Smith and Huffman (1949)

Freezing point

−133°74	Todd, Oliver and Huffman (1947)
−133°792	Streiff, Murphy, Sedlak, Willingham and Rossini (1946)

Specific heat: Todd, Oliver and Huffman (1947) (M.W. 70.130)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −258.67	0.02146	−212.59	0.01473	−145.94	0.30675	−69.49	0.46001
−256.39	0.03057	−205.87	0.18350	L. −132.26	0.45061	−58.84	0.46385
−253.71	0.04406	−199.01	0.19927	−123.37	0.45051	−48.32	0.46844
−249.98	0.05973	−192.80	0.21358	−117.05	0.45029	−37.92	0.47426
−245.80	0.07381	−190.35	0.21875	−113.15	0.45009	−27.66	0.48030
−242.00	0.09128	−186.81	0.22748	−107.64	0.45070	−17.54	0.48738
−237.21	0.1119	−182.27	0.23641	−101.08	0.45157	− 7.56	0.49408
−231.08	0.1315	−180.03	0.24123	− 98.13	0.45215	+ 2.27	0.50141
−224.78	0.14306	−172.71	0.25491	− 91.12	0.45378	11.97	0.50899
−220.85	0.14940	−164.12	0.27079	− 89.16	0.45420	20.74	0.51686
−218.61	0.16393	−155.88	0.28638	− 80.25	0.45642	27.82	0.52243
−213.31	0.16593	−148.08	0.30151	(Values at other temperatures: see authors)			

Heat of melting: 25.911 cal 15°/g Todd, Oliver and Huffman (1947)

HEXENE-1 $CH_2{=}CH-(CH_2)_3-CH_3$

Prepared by the action of allyl bromide on propylmagnesium bromide.

Constants

Boiling point

63°35	Van Risseghem (1926)	63°5	Geldof and Wibaut (1948)

Freezing point: −139° Van Risseghem (1926)

Density

t°	d		t°	d	
0	0.6925	Van Risseghem (1926)	20	0.6736	Wibaut and Geldof
15	0.67875	„	25	0.6689	„ (1946)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He (4713)	He v.	Hγ	
14.9	1.3881	1.3885	—	1.3909	1.39545	1.3967	—	—	1.40155	Van Risseghem (1926)
20	1.3855	1.3858	1.3881	1.3882	1.3929	1.3940	1.3953	1.3976	1.3990	Wibaut and Geldof (1946)
25	—	1.3830	1.3853	1.3854	1.3901	1.3911	1.3924	1.3947	1.3962	
$\frac{dn}{dt}$		0.00056	56	56	56	58	58	58	56	„

A. 3-METHYLPENTENE-2(α) B. 3-METHYLPENTENE-2 (β)

$CH_3-CH{=}C(CH_3)-CH_2-CH_3$

Constants: Howard, Mears, Fookson, Pomerantz and Brooks (1947)

		A	B	
Boiling point		67°8	70°5	Howard, Mears, etc. (1947)
$\frac{dt}{dp}$ *(10 mm)*		0°39	0°37	„
Freezing point		−135°4	−138°5	„
		—	−138°445	Streiff, Zimmerman, Soule, Butt, Sedlak, Willingham and Rossini (1948)
Density	20°	0.6942	0.6986	Howard, Mears, etc. (1947)
	25°	0.6898	0.6942	„
Refractive index	$n_D^{20°}$	1.4016	1.4045	„
	$n_D^{25°}$	1.3989	1.4018	„
	$\frac{dn}{dt}$	0.00054	0.00054	„

2,3-DIMETHYLBUTENE-1 $CH_2{=}C(CH_3)-CH(CH_3)-CH_3$

Constants

Boiling point

55°615	$\frac{dt}{dp}$ *(10 mm)*	0°410	Brooks, Howard and Crafton (1940)
55°641	,,	0°429	Howard, Mears, Fookson, Pomerantz and Brooks (1947)

Freezing point: −140°1 Brooks, Howard and Crafton (1940)

Density

t°	d		t°	d	
20	0.67801	Brooks, Howard and Crafton (1940)	20	0.67792	Howard, Mears, etc. (1947)
25	0.67322	,,	25	0.67312	,,

Refractive index

t°	n_D		t°	n_D	
20	1.39022	Brooks, Howard and Crafton (1940)	20	1.39044	Howard, Mears, etc. (1947)
25	1.38724	,,	25	1.38745	,,
$\frac{dn}{dt}$	0.000596	,,	$\frac{dn}{dt}$	0.00060	,,

3,3-DIMETHYLBUTENE-1 $CH_2{=}CH-C(CH_3)_2-CH_3$

Constants: Brooks, Howard and Crafton (1940)

Boiling point

41°239	$\frac{dt}{dp}$ *(10 mm)*: 0°397

Freezing point

−115°20	Streiff, Murphy, Zimmerman, Soule, Sedlak, Willingham and Rossini (1947)
−115°53	Brooks, Howard and Crafton (1940)

Density

t°	d	
20	0.65293	BROOKS, HOWARD and CRAFTON (1940)
25	0.64786	„

Refractive index

$n_D^{20°}$	1.37604	$n_D^{25°}$	1.37295	$\frac{dn}{dt}$ 0.000618

2,3-DIMETHYLBUTENE-2 $CH_3-C(CH_3)=C(CH_3)-CH_3$

Constants: HOWARD, MEARS, FOOKSON, POMERANTZ and BROOKS (1947)

Boiling point

73°206	$\frac{dt}{dp}$ *(10 mm)*	0°424	HOWARD, MEARS, etc. (1947)
73°24	„	0°414	BROOKS, HOWARD and CRAFTON (1940)

Freezing point: −74°30

Density *Refractive index*

t°	d	t°	n_D	
20	0.70795	20	1.41221	HOWARD, MEARS, etc. (1947)
25	0.70336	25	1.40944	„
		$\frac{dn}{dt}$	0.00055	„

TETRAMETHYLETHYLENE $(CH_3)_2C=C(CH_3)_2$

Prepared by dehydration of dimethyl-*iso*-propylcarbinol by means of sulphuric acid.

Constants

Boiling point *Freezing point*

73°30	KISTIAKOWSKY, RUHOFF, SMITH and VAUGHAN (1936)	−74°2	KISTIAKOWSKY, RUHOFF, SMITH and VAUGHAN (1936)
		−74°6	PARKS, TODD and SHOMATE (1936)

Refractive index

$n_D^{20°}$	1.4124	KISTIAKOWSKY, RUHOFF, SMITH and VAUGHAN (1936)

Specific heat: PARKS, TODD and SHOMATE (1936)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −190.56	0.2222	−141.56	0.3089	L. −70.76	0.4395	−26.86	0.4605
−185.66	0.2330	−132.46	0.3220	−63.36	0.4412	− 9.26	0.4722
−179.36	0.2461	−124.56	0.3340	−58.56	0.4430	+ 3.84	0.4829
−171.96	0.2596	−116.86	0.3453	−46.36	0.4492	9.64	0.4877
−165.06	0.2709	−108.46	0.3610	−40.36	0.4522	18.04	0.4955
−158.16	0.2824	−101.56	0.3774	−31.26	0.4570	22.34	0.4991
−150.16	0.2939						

Heat of melting	15.51 cal 15°/g	PARKS, TODD and SHOMATE (1936)

HEPTENE-1 $CH_2{=}CH-(CH_2)_4-CH_3$

Prepared by the action of allyl bromide on butylmagnesium bromide.

Constants

Boiling point

93°19	KISTIAKOWSKY, RUHOFF, SMITH and VAUGHAN (1936)
93°6	GELDOF and WIBAUT (1948)

Freezing point

−119°1	KISTIAKOWSKY, RUHOFF, SMITH and VAUGHAN (1936)
−119°7	PARKS, TODD and SHOMATE (1936)

Density: 20° 0.6972; 25° 0.6929 WIBAUT and GELDOF (1946)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He (4737)	He v.	Hγ	
20	1.3972	1.3975	1.3999	1.3999	1.4046	1.4058	1.4071	1.4094	1.4108	**WIBAUT and GELDOF (1946)**
25	1.3946	1.3950	1.3973	1.3973	1.4020	1.4032	1.4045	1.4068	1.4082	„
$\frac{dn}{dt}$	0.00052	50	52	52	52	52	52	52	52	„
20	—	—	1.3997	—	—	—	—	—	—	**KISTIAKOWSKY, RUHOFF, etc. (1936)**

Specific heat: Parks, Todd and Shomate (1936)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −192.76	0.1841	−144.66	0.2518	−86.96	0.4436	−30.66	0.4719
−187.56	0.1922	−137.36	0.2617	−76.26	0.4485	−16.36	0.4819
−181.36	0.2017	−130.46	0.2726	−71.26	0.4515	−11.96	0.4855
−174.96	0.2120	L. −122.06	0.4383	−58.06	0.4557	+ 1.74	0.4983
−168.16	0.2215	−113.36	0.4387	−53.66	0.4588	7.24	0.5033
−160.86	0.2317	− 98.36	0.4400	−38.96	0.4656	14.44	0.5092
−152.06	0.2436	− 92.06	0.4421	−34.86	0.4695	22.04	0.5181

Heat of melting	30.82 cal 15°/g	Parks, Todd and Shomate (1936)
Heat of combustion	25° (c_p) 11317.5 „	Coops, Mulder, Dienske and Smittenberg (1946) (M. W. 98.182)

2,3,3-TRIMETHYLBUTENE-1: $CH_2{=}C(CH_3){-}C(CH_3)_3$

Prepared by dehydration of pentamethylethanol, by means of paratoluene sulphonic acid. Chavanne and Van Risseghem (1922); Chavanne and Lejeune (1922)

Constants

Boiling point

78°		Chavanne, etc. (1922)
78°874	$\frac{dn}{dt}$ *(10 mm)*: 0°447	Brooks, Howard and Crafton (1940)

Freezing point

−110°2	Chavanne, etc. (1922)
−111°40	Brooks, Howard and Crafton (1940)

Critical solution point

in $C_6H_5NH_2$	35°2	Chavanne, etc. (1922)

Density

t°	d		t°	d	
0	0.7235	Chavanne, etc. (1922)	20	0.70501	Brooks, Howard and Crafton (1940)
15	0.7101	„	25	0.70054	„

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
0	627	25	445	Chavanne, etc. (1922)
15	509	30	421	,,
20	480			,,

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.4032	1.4059	1.4119	1.4164	Chavanne etc. (1922)
20	—	1.40292	—	—	Brooks, Howard and Crafton (1940)
25	—	1.40004	—	—	,,
$\frac{dn}{dt}$	—	0.000576	—	—	,,

3-ETHYLPENTENE-2 $CH_3-CH=C(C_2H_5)-CH_2-CH_3$

Constants: B.E. (unp.)

Boiling point: 95°4

Density *Viscosity* *Surface tension*

t°	d	t°	$\eta \cdot 10^5$	t°	γ	
0	0.73795	15	377	15	21.97	B.E. (unp.)
15	0.72489	30	325	20	21.42	,,
30	0.71211			30	20.40	,,

Refractive index

t°	He r.	He y.	He g.	He v.	
15	1.41473	1.41777	1.42284	1.42807	B.E. (unp.)
$\frac{dn}{dt}$	0.00048	49	49	49	,,

Dielectric constant: 20° 2.052 Piette (unp.)

6-METHYLHEPTENE-1 $CH_2=CH-(CH_2)_3-CH(CH_3)-CH_3$

Boiling point, density and *refractive index* Cleveland (1943)

Eykman in his posthumous works, Wibaut and Geldof (1946), Howard, Mears, Fookson, Pomerantz and Brooks (1947) have studied the long-chain ethylenic hydrocarbons. These seem to have been carefully purified.

C. DIENES

BUTADIENE-1,3 $CH_2{=}CH{-}CH{=}CH_2$

Constants: Scott, Meyers, Rands Jr, Brickwedde and Bekkedahl (1945)

Critical constants

t° cr.	p cr. mm	d cr.	
152	32420	0.245	

Saturated vapour pressure:

$$\log p = A - \frac{1}{T}[B + CX(10^{DX^2} - 1)] - E(T - 243.16)^6$$

where

$A = 7.2363$ for p in mm Hg
$B = 1165{,}21$
$C = 1.5875 \times 10^{-4}$
$D = 0.766 \times 10^{-10}$
$X = 125{,}000 - T^2$
$E = 2 \times 10^{-14}$ (not to be used above − 30° C)
$T = t + 273.16$ = temperature in Kelvin degrees

Melting point

−108°917	Scott, Meyers, etc. (1945)
−108°917	Glasgow Jr., Krouskop, Beadle, Axilbrod and Rossini (1948)

Specific heat: (M.W. 54.088)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −258.16	0.0178	−188.16	0.2200	L. −108.16	0.4568	−38.16	0.4841
−253.16	0.03566	−183.16	0.2291	−103.16	0.4570	−33.16	0.4874
−248.16	0.05596	−178.16	0.2379	− 98.16	0.4578	−28.16	0.4912
−243.16	0.07633	−173.16	0.24626	− 93.16	0.4585	−23.16	0.4955
−238.16	0.09590	−168.16	0.25425	− 88.16	0.4594	−18.16	0.4994
−233.16	0.1138	−163.16	0.26206	− 83.16	0.4609	−13.16	0.5037
−228.16	0.1302	−158.16	0.27041	− 78.16	0.4623	− 8.16	0.5082
−223.16	0.1454	−153.16	0.27932	− 73.16	0.4640	− 3.16	0.5132
−218.16	0.1591	−148.16	0.28855	− 68.16	0.4661	+ 1.84	0.5187
−213.16	0.1706	−143.16	0.29835	− 63.16	0.4688	6.84	0.5242
−208.16	0.1800	−138.16	0.30899	− 58.16	0.4716	11.84	0.5302
−203.16	0.1904	−133.16	0.32061	− 53.16	0.4740	16.84	0.5362
−198.16	0.2006	−128.16	0.33328	− 48.16	0.4774		
−193.16	0.2104	−123.16	0.34712	− 43.16	0.4805		

Heat of vaporisation	t°	cal 15°/g	
	−26°09 − 4°56 +22°51	104.22 99.440 92.756	Scott, Meyers, etc. (1945) „ „

Heat of melting	35.283 cal 15°/g	Scott, Meyers, etc. (1945)
Heat of combustion	25° (c_p) 11144.6 „	Prosen and Rossini (1945) (M. W. 54.088)

PENTADIENE-1,4 $CH_2{=}CH-CH_2-CH{=}CH_2$

This product is prepared by allowing the ether of α α′ diallyl β β′ dibromodiethylether to react with *n*-butylalcohol and zinc.

Constants

Boiling point

26°02	Kistiakowsky, Ruhoff, Smith and Vaughan (1936)

Freezing point

−148°1 −148°8	Parks, Todd and Shomate (1936) Kistiakowsky, Ruhoff, etc, (1936)

Specific heat: Parks, Todd and Shomate (1936)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −190.76	0.2197	L. −147.76	0.4506	−84.96	0.4471	−17.56	0.4830
−184.86	0.2308	−141.56	0.4469	−78.56	0.4498	−12.46	0.4870
−178.66	0.2424	−135.56	0.4454	−72.86	0.4526	− 7.46	0.4913
−172.16	0.2553	−123.66	0.4438	−58.76	0.4587	+ 2.14	0.5002
−170.26	0.2620	−117.66	0.4437	−53.46	0.4609	11.74	0.5065
		−111.46	0.4429	−48.16	0.4630	15.54	0.5091
		− 95.76	0.4456	−34.76	0.4709	29.34	0.5114
		− 90.56	0.4468	−29.56	0.4742		

Heat of melting	21.55 cal 15°/g	Parks, Todd and Shomate (1936)

2-METHYLBUTADIENE-1,3 or ISOPRENE $CH_2{=}C(CH_3)-CH{=}CH_2$

This hydrocarbon is obtained by decomposition of dipentene vapour by means of the "isoprene lamp" after the method devised by Harries and Gottlob (1911) and modified by Whitby and Crozier (1932).

Constants: Bekkedahl, Wood and Wojciechowsky (1936)

Boiling point *Freezing point*

34°076	Bekkedahl, Wood, etc. (1936)	−145°950	Glasgow Jr., Krouskop, Beadle, Axilbrod and Rossini (1948)
34°3	Lecat (passim)	−146°7	Bekkedahl, Wood, etc. (1936)
		−146°8	Bekkedahl and Wood (1937)

Density: 20° 0.6805

$$d_t = 0.7002 - 0.9754 \cdot 10^{-3} t^{\circ} - 0.592 \cdot 10^{-6} t^{\circ 2} + 0.525 \cdot 10^{-9} t^{\circ 3} + 9.66 \cdot 10^{-12} t^{\circ 4}$$

Refractive index: $n_D^{20^\circ}$ 1.42160 $\frac{dn}{dt}$ 0.00045

Specific heat

t°	c_p	t°	c_p	t°	c_p
C. −249.75	0.05574	−173.19	0.2297	−38.81	0.47172
−244.50	0.07674	L. −133.01	0.43157	−29.02	0.47955
−238.99	0.09560	−127.04	0.43249	−27.45	0.48159
−233.85	0.1110	−111.19	0.43438	−19.70	0.48759
−228.76	0.1253	−103.55	0.43516	−16.11	0.49097
−220.59	0.1421	− 94.37	0.43737	−10.37	0.49739
−213.33	0.1575	− 85.14	0.44144	− 4.70	0.50319
−205.80	0.1721	− 76.96	0.44506	− 1.12	0.50719
−198.86	0.1849	− 72.93	0.44703	+ 5.39	0.51446
−191.34	0.1988	− 69.84	0.44864	8.06	0.51748
−187.36	0.2035	− 66.39	0.44963	14.45	0.52440
−183.38	0.2126	− 61.55	0.45409	17.24	0.52679
−181.09	0.2157	− 57.05	0.45648	23.49	0.53434
−180.54	0.2158	− 50.18	0.46297	25.30	0.53838
−175.76	0.2259	− 47.70	0.46304		

Heat of melting	**16.8 cal 15°/g**	**Bekkedahl and Wood (1937)**
Heat of combustion	**25° (c_p) 11089.5 „**	**Jessup (1938) (M. W. 68.0498)**

D. ACETYLENES

ACETYLENE C_2H_2

Is purified by allowing the gas to bubble through a solution of concentrated potassium permanganate, drying over P_2O_5 and fractionating under reduced pressure at low temperature.

Constants

Critical constants

t° cr.	p cr. atm.	d cr.	
35.50	61.65	—	Cardoso (1912)
35.4	—	0.2315	Mathias (1909)

Densities of the liquid and the saturated vapour: Mathias (1909)

t°	L.	V.	t°	L.	V.
−23.75	0.5185	0.0217	28.98	0.3559	0.1160
+ 6.11	0.4476	0.0528	29.07	0.3556	0.1163
12.05	0.4295	0.0632	31.43	0.3379	0.1305
17.07	0.4120	0.0740	32.09	0.3315	0.1361
20.30	0.3987	0.0831	32.88	0.3282	0.1393
23.42	0.3859	0.0925	33.74	0.3146	—
24.11	0.3814	0.0958	35.4	0.2315	0.2315

Weight of the normal litre in the gaseous state: 1.17910 Stahrfoss (1918)
Deviation from Avogadro's law: $A_0^1 = 1.00884$ Howarth and Burt (1924—25)

PROPYNE or METHYLACETYLENE (ALLYLENE) $CH{\equiv}C{-}CH_3$

Prepared by the reaction of propylene bromide with alcoholic soda. Purified by repeated fractional distillation or by means of the copper salt or by way of the sodium derivative.

Saturated vapour pressure: Heisig and Hurd (1933)

t°	p mm	t°	p mm	t°	p mm
−79.5	26.7	−52.5	169.6	−33.0	478.2
−75.2	37.1	−45.6	249.9	−27.8	612.3
−71.0	49.3	−38.7	361.6	−23.5	743.5
−64.2	80.7				

Boiling point: − 23°1 Heisig and Hurd (1933)

BUTYNE-2 or 1,2-DIMETHYLACETYLENE $CH_3-C\equiv C-CH_3$

Prepared from an equimolecular mixture of methyl iodide and the sodium compound of methylacetylene. The product cristallizes on cooling and is purified by washing and fractional distillation.

Constants

Saturated vapour pressure: Heisig and Davis (1935)

t°	p mm	t°	p mm
L. 0	252.8	S. −38.70	27.9
−31.2	49.3	−34.55	38.6

Boiling point: 27°2 Heisig and Davis (1935)

Melting point

−32°23	Yost, Osborne and Garner (1941)
−32°260	Streiff, Murphy, Zimmerman, Soule, Sedlak, Willingham and Rossini (1947)
−32°5	Heisig and Davis (1935)

Specific heat: Yost, Osborne and Garner (1941) (M.W. 54.089)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −258.46	0.0136	−222.76	0.1547	−160.12	0.3167	−82.15	0.3517
−256.20	0.01928	−215.92	0.1792	−154.92	0.3262	−77.04	0.3564
−254.08	0.02587	−211.59	0.1936	−149.52	0.3347	−71.10	0.3631
−252.13	0.03256	−207.02	0.2084	−143.92	0.3451	−64.09	0.3707
−250.11	0.04015	−202.05	0.2231	−143.85	0.3452	−56.94	0.3801
−247.96	0.04897	−196.76	0.2385	−138.96	0.3547	−49.69	0.3927
−245.75	0.05823	−191.19	0.2525	−133.87	0.3646	−42.46	0.4265
−243.41	0.06790	−185.36	0.2662	—	—	L. − 8.21	0.5345
−241.20	0.07781	−180.79	0.2762	−108.86	0.3254	+ 1.55	0.5401
−238.79	0.08856	−175.62	0.2866	−103.33	0.3308	11.17	0.5461
−235.50	0.1026	−170.67	0.2969	− 97.81	0.3360		
−231.29	0.1201	−165.50	0.3067	− 92.58	0.3406		
−227.22	0.1368			− 87.33	0.3467		

(Between 130° and 110°, the heat capacity is abnormally high)

Heat of vaporisation	17°84 119.2 cal 15°/g	Yost, Osborne and Garner (1941)
Heat of melting	40.8 „	„

HEXYNE-1 or *n*-BUTYLACETYLENE $CH\equiv C-(CH_2)_3-CH_3$

Prepared by the action of alcoholic potash on dibromo 1,2-hexane, purified by washing with water, drying over Na_2CO_3 and subjecting to fractional distillation.

Constants: VAN RISSEGHEM (1926)

Boiling point: 71°38

Freezing point: −124°

Density

t°	d	
0 15	0.7336 0.7193	

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	Hγ
15	1.3991	1.3994	1.40195	1.40615	1.4076	1.4125

In EYKMAN's posthumous papers information may be found concerning heptyne-1 $C_5H_{11}C\equiv CH$, undecyne-1 $C_9H_{19}C\equiv CH$, hexadecyne-1 $C_{14}H_{29}C\equiv CH$, octadecyne-1 $C_{16}H_{33}C\equiv CH$.

E. AROMATIC HYDROCARBONS

BENZENE C_6H_6

The purification is carried out in two stages:

(1) It is necessary first to eliminate, by chemical means, the thiophen, which gives mixed crystals with benzene; this result is attained either by shaking the benzene with a little concentrated sulphuric acid (MEYER, 1910), or by boiling it over mercuric oxide (DIMROTH, 1899) or over anhydrous aluminium chloride (HALLER, 1892). The best criterion for the absence of thiophen is the indophenin reaction (MEYER, 1910; GILLO, 1938).

(2) The purification is continued by physical methods of fractionation which result in the elimination of traces of homologues and of hydrocarbons belonging to other series. The fractional distillation is followed by fractional melting until the melting point is constant or by crystallization from aqueous alcohol (SWIETOSLAWSKI).

Ewins (1914) used as a supplementary criterion of purity the critical solution point with anhydrous formic acid (81°9).

Gillo (1938–39) determined the traces of impurities contained in benzene which had been purified in this manner, and obtained benzene containing less than 10^{-3} % of water and less than $2 \cdot 10^{-5}$ % of thiophen: the latter was determined by chromometry (mercury salt) and colorimetry (isatin). It is easy to attain the fifth degree of purity ($\Delta t = 0.000°$) as shown by the ebulliometer of **Swietoslawski**.

Wojciechowski (1936) has made a very careful study of benzene at the National Bureau of Standards.

Intensive dessication of benzene by purified P_2O_5 produces variations in the physical constants of benzene, especially in the vapour pressure (**Lacoss** and **Menzies** (1937).

Constants: B.E. (1926). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
288°5	36400	0.3045	Young (1910)
288°5	—	0.3044	Simon (1938)
288°68	37460	—	Schamhardt (1908)

Densities of the liquid and the saturated vapour: Young (1900—10)

t°	L.	V.	t°	L.	V.
0	0.90006	0.00012	170	0.7043	0.02087
10	0.8895	0.0002	180	0.6906	0.02487
20	0.8790	0.0004	190	0.6758	0.02977
30	0.8685	0.0006	200	0.6605	0.03546
40	0.8576	0.0008	210	0.6432	0.04207
50	0.8466	0.0011	220	0.6255	0.05015
60	0.8357	0.0015	230	0.6065	0.05977
70	0.8248	0.002040	240	0.5851	0.07138
80	0.8145	0.002732	250	0.5609	0.08554
90	0.8041	0.003610	260	0.5328	0.1038
100	0.7927	0.004704	270	0.4984	0.1287
110	0.7809	0.006042	280	0.4514	0.1660
120	0.7692	0.007675	284.3	0.4213	—
130	0.7568	0.009851	286.1	0.4078	—
140	0.7440	0.01176	288.0	0.3856	—
150	0.7310	0.01437	288.5	0.3045	0.3045
160	0.7185	0.01734			

Rectilinear diameter: $0.4501 - 5248 \cdot 10^{-7} t^{\circ} + 693 \cdot 10^{-10} t^{\circ 2}$ Young (1900—10)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−35.1	1.381	−48.8	0.361			Mündel (1913)
−43.8	0.606	−52.4	0.247			,,
−45.5	0.510	−56.0	0.217			,,
		−58.6	0.124			,,
−10	(S) 14.97	110	1739	220	14521	Young (1910)
0	(L) 26.54	120	2230	230	16825	,,
10	45.19	130	2821	240	19352	,,
20	74.13	140	3520	250	22182	,,
30	117.45	150	4335	260	25329	,,
40	180.20	160	5300	270	28852	,,
50	268.30	170	6386	280	32782	,,
60	388.51	180	7617	284.30	34594	,,
70	548.16	190	9045	286.1	35436	,,
80	755.0	200	10650	288.0	36226	,,
90	1008	210	12453	288.5	36395	,,
100	1335					,,
0	26.524	40	181.108	90	1016.12	Fiock, Ginnings and Holton (1931)
10	45.448	50	268.964	100	1344.44	
20	74.632	60	388.588	110	1748	,,
25	93.860	70	547.428	120	2238.20	,,
30	118.256	80	753.616	130	2824.92	,,
8.86	42.6	24.00	89.7	54.87	312.4	Schmidt (1934)
10.20	45.5	26.01	98.4	56.95	347.1	,,
12.10	50.4	30.73	122.0	58.81	372.1	,,
13.70	54.8	33.45	136.9	63.33	437.0	,,
14.11	56.1	34.67	144.5	64.49	454.7	,,
15.20	58.8	40.25	183.0	69.57	540.9	,,
16.31	62.4	42.65	201.7	76.22	671.9	,,
18.59	69.7	46.20	231.2	80.00	756.2	,,
20.20	75.6	49.92	267.5	80.15	760.0	,,
20.54	76.7	50.00	268.3	81.30	789.2	,,
22.99	86.1	50.72	276.0			,,
14.548	57.41	39.078	175.89	74.028	627.93	Willingham, Taylor,
17.720	67.22	44.284	217.16	78.891	732.07	Pignocco and Rossini
20.594	77.28	49.066	261.75	79.413	744.04	,, (1945)
23.270	87.75	54.832	324.93	79.898	755.23	,,
26.886	103.64	60.784	402.42	80.442	767.94	,,
31.004	124.67	67.135	500.69	80.922	779.34	,,
35.191	149.43					,,

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
17.72	67.18	31.62	127.34	—	—	Dejardin (1919)
21.54	80.51	35.11	148.05	80.0	756.49	„
24.22	91.43	38.54	170.95	80.15	760.00	„
28.85	112.63	41.20	190.82	80.35	764.68	„
23.6	88.5	40.8	187.4	51.3	284.0	Jolly and Briscoe (1926)
29.2	114.5	43.7	210.8	53.2	305.3	„
33.5	138.6	46.5	235.6	54.8	325.6	„
37.2	161.7	48.8	258.3			„
24.368	92.52	51.672	289.13	80.098	760.00	Smith (1941)
29.739	118.06	57.267	355.22	85.918	906.06	„
35.155	149.40	62.908	433.56	91.783	1074.58	„
40.616	187.57	68.593	526.86	97.693	1268.03	„
46.121	233.72	74.323	633.99	103.647	1489.14	„
26.3	100	60.9	401			Schreinemakers (1904)
35.4	150.2	67.3	500.5			„
42.5	202.1	73.0	601.6			„
47.8	249.6	77.7	700.7			„
52.9	301.4	79.2	731.1			„
36.73	155.8	55.09	326.7	69.67	544.7	Gilmann and Gross (1938)
40.90	188.5	60.63	389.9	74.98	646.0	„
45.13	223.9	64.89	461.2	79.78	753.0	„
50.19	272.1					„
59.796	388.58	99.615	1344.3	—	—	Zmaczynski (1930)
69.846	547.40	109.762	1748.2	—	—	[see also Swietoslawski
79.849	753.62	—	—	—	—	„ (1930)]
89.988	1016.1	—	—	—	—	„
63.16	439.1	80.30	765.5	105.97	1501	Smith and Menzies (1910)
66.55	492.0	90.48	1031	111.54	1820	„
71.09	563.7	95.67	1197	119.93	2235	„
74.79	640.8	100.42	1364			„
230.10	16830	271.18	30058	—	—	Schamhardt (1908)
241.32	19990	281.42	34088	—	—	„
251.38	22950	285.70	34758	—	—	„
257.14	24510	—	—	—	—	„
25	94.91	—	—	—	—	Hovorka and Dreisbach (1934)
49.99	268.0	—	—	—	—	Zawidsky (1900)

Scatchard, Wood and Mochel (1939) have done very careful work, but their values are in disagreement with those of the other authors.

Boiling point

All modern measurements give values between 80°05 and 80°15.

80°07	Maryott, Hobbs and Gross (1940)	80°094	Smith and Matheson (1938) and Wojciechowski (1937)
80°08	Gibbons, Thompson, Reynolds, Wright, Chanan, Lamberti, Hipsher and Karabinos (1946)	80°106	Zmaczynski (1930)
		80°103	Forziati, Glasgow Jr., Willingham and Rossini (1946)
80°093	Wojciechowski (1936)	80°105	Scatchard, Wood and Mochel (1939)

$\frac{dt}{dp}$ (10 mm)

0°422	Schmidt (1934)	0°4279	Zmaczynki (1930)
0°4268	Smith and Matheson (1938)	0°43	Crafts (1887)
0°427	Dejardin (1919)	0°43	Young (1900–10)
0°4273	Forziati, Glasgow Jr., etc.(1946)	0°43	Lecat (passim)

Freezing point

5°496	Davison (1945)	5°530	Streiff and Rossini (1944)
5°50	B.E. (1926) and Deffet (1935)	5°53	Simonsen and Washburn (1946)
5°50	Gibbons, Thompson, etc. (1946)	5°53	Tompa (1948)
5°50	Linton (1940)	5°533	Forziati, Glasgow Jr., etc.(1946) and Glasgow Jr., Murphy, Willingham and Rossini (1946)
5°51	Wojciechowski (1937)		
5°53	Tompa (1948)		

Triple point

5°525	Oliver, Eaton and Huffman (1948)

Melting curve

t°	p kg/cm²	t°	p kg/cm²	
5.50	1	25.00	728	Deffet (1935)
10.00	166	30.00	917	„
15.00	349	32.00	993	„
20.00	538			„

Constants of state

Density

t°	d		t°	d	
0	0.89996	B.E. (1926)	25	0.87366	Simonsen and Washburn (1946)
15	0.88420	„			
30	0.86844	„			
			25	0.87366	Wojciechowski (1937)
0	0.89990	Massart (1936)	25	0.87367	„
14.95	0.88434	„			
30.10	0.86828	„	0	0.90006	Young (1910)
45.95	0.85104	„	10	0.8895	„
			15	0.8842	„
0	0.89993	Biron (1910)	20	0.8790	„
40	0.8573	„	25	0.8737	„
			30	0.8685	„
16.2	0.8828	Kalff (1924)	40	0.8576	„
16.35	0.8826	„	50	0.8466	„
			60	0.8357	„
17.95	0.88112	Patterson (1902)			
25.25	0.87336	„	20.00	0.87909	Cohen and Burij (1937)
32.90	0.86514	„	24.00	0.87485	„
42.65	0.85462	„	28.00	0.87058	„
47.05	0.84989	„	32.00	0.86624	„
			36.00	0.86206	„
20	0.87903	Forziati, Glasgow Jr.,	40.00	0.85769	„
25	0.87368	„ etc. (1946)	44.00	0.85343	„
25	0.87368	Scatchard, Wood and Mochel (1946)	48.00	0.84913	„
			52.00	0.84469	„
30	0.86836	„	56.00	0.84032	„
			60.00	0.83602	„
10	0.88946	Tyrer (1914)			
15.8	0.8835	Meyer and Mylius (1920)	25	0.87368	Linton (1940)
17	0.88195	Schmidt (1926)	25	0.87368	Le Fevre and Le Fevre (1936)
20	0.87888	Zmaczynski (1930)			
20	0.8789	Grosse and Wackher (1939)	25	0.87370	Few and Smith (1949)
20	0.8789	Gibbons, etc. (1946)	25	0.87376	Campbell and Miller (1947)
20	0.87893	Briscoe, Peel and Robinson (1929)			
20	0.8790	Coulson, Hales and Herington (1948)	30	0.86840	de Bruyne, Davis and Gross (1933)
20	0.8790	Dezelic (1937)			
20	0.8791	Weegman (1888)	50	0.8468	Hubbard (1910)
25	0.87360	Olsen and Washburn (1935)			
25	0.87363	Barbaudy (1926)			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0.15	910	Meyer and Mylius (1920)	12.20	737	Kolossowski (1925)
15.8	690	„	16.32	692	„
17.2	680	„	17.15	684	„
28.8	571	„	22.50	624	„
36.0	530	„	28.73	573	„
46.5	465	„	31.30	550	„
58.3	402	„	35.10	520	„
67.9	365	„	40.02	482	„
72.7	350	„			
14.8	708.0	Heydweiller (1896)	15	696	B.E. (1926)
30.8	554.4	„	30	566	„
46.9	447.9	„	60	395	„
20	649	Dezelic (1937)	25.0	599	Linebarger (1896–1897)
25	596.1	Lewis (1924)	25.0	601	Dunstan, Hilditch and Thole (1913)
30	569	Puschin and Pinter (1929)			

Surface tension

t°	γ		t°	γ	
0	31.87	Richards, Speyers and	13.5	29.72	Sugden (1924)
34.95	26.99	„ Carver (1924)	20	28.88	„
6.7	30.49	Schiff (1884)	21.0	28.74	„
10	30.26	Harkins and Cheng (1921)	32.5	27.30	„
20	28.90	„	34.5	26.98	„
30	27.61	„	39.0	26.36	„
15	29.55	Hennaut-Roland and	41.5	26.08	„
20	28.88	„ Lek (1931)	54.8	24.28	„
30	27.57	„	61.0	23.61	„
20	28.88	Richards and Carver	72.0	22.15	„
		(1921) and Richards and	90	20.13	„
		Coombs (1915)	120	16.42	„
20	28.88	Harkins and Brown (1919)			
20	28.89	Brown (1932)			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
11.27	1.50123	—	—	1.50676	1.51639	—	—	—	Kalff (1924)
32.7	1.48742	—	—	1.49277	1.50211	—	—	—	,,
$\frac{dn}{dt}$	0.000635	—	—	0.000652	0.000666	—	—	—	,,
15	—	1.49952	1.50439	1.50446	—	1.51633	—	1.52681	B.E. (1926)
$\frac{dn}{dt}$	—	0.00063	63	63	—	64	—	65	,,
16.5	—	—	1.5033	—	—	—	—	—	Puschin and Matavulj (1932)
20.0	—	—	1.5010	—	—	—	—	—	
$\frac{dn}{dt}$	—	—	0.0006	—	—	—	—	—	,,
20	—	—	1.50110	—	—	—	—	—	Forziati, Glasgow, etc. (1946)
25	—	—	1.49790	—	—	—	—	—	
$\frac{dn}{dt}$	—	—	0.00064	—	—	—	—	—	,,
15	—	—	—	1.50439	—	—	—	—	Zmaczynski (1930)
20	—	1.4963	1.5009	1.5012	1.5110	1.5133	—	—	Lowry and Allsopp (1931)
20	—	1.4960	—	—	—	—	—	—	Michielewicz (1938)
20	—	—	1.5009	—	—	—	—	—	Marschner and Cropper (1946)
20	—	—	1.5010	—	—	—	—	—	Harrison and Berg (1946)
20	—	—	1.5011	—	—	—	—	—	Gibbons, etc. (1946)
20	—	—	1.5011	—	—	—	—	—	Coulson, Hales, etc. (1948)
20	—	—	1.5011	—	—	—	—	—	Grosse and Wackher (1939)
20	—	—	1.50115	—	—	—	—	—	Davies (1936)
25	—	—	1.4979	—	—	—	—	—	Cohen and Buij (1937)
25	—	—	1.49794	—	—	—	—	—	Hubbard (1910)
25	—	1.49331	1.49795	—	—	1.50985	—	1.52019	Barbaudy (1926)
25	—	1.49331	1.49797	—	—	—	—	—	Campbell and Miller (1947)
25	—	—	1.49807	—	—	—	—	—	Wojciechowski (1936–37)
25	—	—	1.49807	—	—	—	—	—	Simonsen and Washburn (1946)
25	—	—	1.4981	—	—	—	—	—	Few and Smith (1949)
25	—	—	1.4981	—	—	—	—	—	Tompa (1948)
25.2	—	—	1.49779	—	—	—	—	—	Zawidzki (1900)
30	—	—	1.49486	—	—	—	—	—	de Bruyne, etc. (1933)

Dielectric constant

t°	ε		t°	ε	
5.5	2.311	Errera (1926)	9.2	2.306	Hadamard (1937)
10	2.3024	Le Fevre (1938)	9.9	2.304	„
15	2.2925	„	12.3	2.2975	„
30	2.2628	„	14.1	2.294	„
45	2.2331	„	15.8	2.293	„
55	2.2133	„	16.7	2.290	„
65	2.1935	„	17.8	2.288	„
15.3	2.2951	Vaughan (1939)	20.8	2.282	„
19.0	2.2884	„	21.7	2.280	„
21.0	2.2790	„	29.3	2.2675	„
20	2.2825	Davies (1936)	30.3	2.266	„
25	2.2726	„	31.1	2.263	„
20	2.2829	Mouradoff (unp.)	32.5	2.261	„
			33.2	2.259	„
25	2.273	Jenkins and Sutton(1935)	34.5	2.258	„
25	2.274	Lunt and Ran (1930)	34.9	2.256	„
25	2.274	Ball (1930)	35.8	2.255	„
30	2.2627	Maryott, Hobbs and Gross (1940)	40.3	2.247	„
			18	2.288	Grimm and Patrick (1923)
			25	2.272	Sugden (1933)
			25	2.2725	Le Fevre and Le Fevre (1936)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −173.16	0.154	− 93.16	0.231	−13.16	0.355	Stull (1937)
−163.16	0.162	− 83.16	0.244	− 3.16	0.376	„
−153.16	0.170	− 73.16	0.258	L. + 6.84	0.397	„
−143.16	0.179	− 63.16	0.271	16.84	0.406	„
−133.16	0.188	− 53.16	0.286	26.84	0.413	„
−123.16	0.198	− 43.16	0.301	36.84	0.420	„
−113.16	0.209	− 33.16	0.317	46.84	0.430	„
−103.16	0.219	− 23.16	0.335			„
C. −180.56	0.148	−95.06	0.229	L. +7.94	0.403	Huffman, Parks and Daniels (1930)
−175.26	0.152	−78.16	0.250	9.94	0.404	
−170.16	0.156	−71.66	0.260	13.14	0.406	„
−159.36	0.165	−55.06	0.283	16.74	0.408	„
−143.36	0.180	−43.46	0.301	21.74	0.410	„
−130.16	0.192	−33.66	0.317	26.84	0.414	„
−122.46	0.200	−23.06	0.335			„
−110.96	0.211	−13.66	0.355			„

Specific heat (continued)

t°	c_p	t°	c_p	t°	c_p	
C. −260.19	0.0088	−201.44	0.1294	−47.63	0.29472	Oliver, Eaton and
−258.91	0.0111	−194.96	0.13597	C. −38.97	0.30843	Huffman (1948)
−258.39	0.0123	−187.58	0.14288	−38.06	0.31008	(M.W. 78.108)
−256.64	0.01627	−179.81	0.14922	−30.37	0.32397	,,
−256.21	0.01730	−171.51	0.15569	−28.14	0.32779	,,
−253.52	0.02451	−163.04	0.16248	−21.13	0.34060	,,
−253.13	0.02538	−154.97	0.16905	−18.65	0.34528	,,
−250.12	0.03445	−147.34	0.17569	−11.75	0.35743	,,
−249.49	0.03635	−139.36	0.18274	−10.00	0.36195	,,
−246.39	0.04574	−131.32	0.19006	− 3.74	0.37704	,,
−245.69	0.04763	−123.57	0.19764	− 2.88	0.37916	,,
−242.57	0.05672	−117.08	0.20428	− 2.58	0.37941	,,
−241.39	0.06019	−115.70	0.20558	L. +13.74	0.40911	,,
−236.65	0.07292	−108.26	0.21328	16.21	0.41082	,,
−231.48	0.08496	− 99.77	0.22285	21.80	0.41441	,,
−226.07	0.09587	− 91.60	0.23260	27.25	0.41807	,,
−220.48	0.1055	− 83.24	0.24318	36.57	0.42416	,,
−219.09	0.1077	− 74.26	0.25491	45.76	0.43069	,,
−215.07	0.1135	− 65.17	0.26799	54.81	0.43769	,,
−213.83	0.1153	− 56.43	0.28087	63.73	0.44422	,,
−207.64	0.1231					,,
L. 20.22	0.412	30.98	0.419	42.80	0.429	Trehin (1921)
24.04	0.415	34.83	0.424	46.77	0.433	,,
27.57	0.418	38.84	0.426	50.44	0.437	,,

Heat of vaporisation	10°	105.2	cal 15°/g	Smits and Cannegieter (1934)
	25°	103.571	,,	Osborne and Ginnings (1947)
	50°	99.29	,,	Fiock, Ginnings and Holton (1931)
	80°	94.16	,,	,,
	110°	88.51	,,	,,
Heat of melting		30.45	,,	Meyer (1910)
Heat of combustion	25° (c_p)	9992.7	,,	Coops, Mulder, Dienske and Smittenberg (1946) (M.W. 78.108)
	25° (c_p)	9998.7	,,	Prosen, Gilmont and Rossini (1945) (M. W. 78.108)

TOLUENE C_6H_5—CH_3

Method of purification

The impurities of crude toluene are of the same type as those of benzene, and it is practically impossible to eliminate them all by physical methods alone; small quantities of saturated hydrocarbons of the aliphatic series or of polymethylenes are practically without influence on the boiling point. In order to obtain pure toluene it is therefore necessary to transform it into a crystallisable substance such as *para*-toluene sulphonic acid or *para*-toluidine, and after purification of that derivative to regenerate the hydrocarbon. Since they had not been submitted to this treatment, practically the whole of the samples in the literature are relatively very impure, and this is especially to be noted from their very low density, as for instance the sample which TIMMERMANS used for his measurements of densities at low temperatures.

According to LUMSDEN (1919), the addition to pure toluene of 1 % of a petrol fraction with a boiling point around 110°, lowers the density by 0.0013. ORTON and JONES (1919) use as criterion of purity the critical solution point in acetic acid with a known percentage of water; it is stated that the elevation of the critical solution point is 1°4 for 1 % of paraffin.

The new measurements of ZMACZYNSKI (1930) have been carried out on a toluene of very constant boiling point, but its low density shows that it is still appreciably contaminated with other hydrocarbons.

The velocity of crystallisation is in this case an extremely sensitive criterion of purity: MICHEL (1938) found for the velocity of crystallisation at −110°, 29.2 cm/min.

Constants: B.E. (1926). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. atm.	d cr.	
319°9	—	0.2913	SIMON (1938)
320°6	41.60	—	KRASE and GOODMAN (1930)
320°8	—	—	FISCHER and REICHEL (1943)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
0.0	6.75	25.0	28.40	50.0	92.00	PITZER and SCOTT (1943)
12.5	14.40	37.5	52.70			,,

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
13.72	15.3	42.09	65.2	74.23	236.9	Schmidt (1934)
17.68	19.7	52.04	101.5	77.95	270.3	„
24.85	28.1	57.87	127.6	79.82	289.6	„
25.14	29.2	59.96	139.0	82.51	317.5	„
28.42	33.7	63.57	160.1	85.58	351.1	„
32.24	41.1	66.53	178.5	88.47	385.4	„
36.35	50.2	69.32	198.4			„
21.98	22.0	50.35	92.5	80.88	298.9	Schouteden and Deveux
30.09	34.5	60.62	141.4	90.95	418.9	„ (1936)
40.29	58.0	70.59	207.7	100.21	558.6	„
35.366	47.68	61.851	149.43	104.037	627.93	Willingham, Taylor,
39.343	57.41	66.079	175.89	109.312	732.08	Pignocco and Rossini
42.810	67.22	71.738	217.16	109.879	744.05	„ (1945)
45.948	77.28	76.942	261.75	110.403	755.24	„
48.867	87.75	83.202	324.93	110.991	767.95	„
52.802	103.64	89.667	402.43	111.509	779.34	„
57.293	124.67	96.559	500.68			„
79.772	289.1	110.603	760.00	142.563	1741.0	Zmaczynski (1930)
85.849	355.1	116.908	906.1	149.089	2026.3	„
91.971	433.9	123.254	1074.6	155.656	2347.4	„
98.137	525.76	129.646	1268.1			„
104.349	633.90	136.082	1489.2			„
110.7	760.0	149.5	2128.0	161.0	2926.0	Krase and Goodman
129.5	1276.8					„ (1930)

t°	p atm.	t°	p atm.	t°	p atm.	
175.5	5.18	234.5	13.25	279.5	24.81	Krase and Goodman
186.5	6.12	246.0	16.00	280.0	25.10	„ (1930)
194.0	6.98	250.0	17.05	283.0	26.00	„
203.5	8.26	253.5	17.46	301.5	32.40	„
214.4	9.89	257.2	17.69	320.0	41.48	„
226.0	11.88	264.0	21.39			„

Boiling point: Most of the recent values are between 110°6 and 110°8

110°606	Zmaczynski (1930) (B. E.'s sample)	110°623	Forziati, Glasgow Jr., Willingham and Rossini (1946)
		110°75	Lecat (passim)

$\frac{dt}{dp}$ (10 mm)

0°4630	Forziati, etc. (1946)	0°4640	Zmaczynski (1930)

Freezing point

−94°983	Mair, Glasgow Jr and Rossini (1941)	−95°032	Forziati, Glasgow Jr, Willingham and Rossini (1946)
−94°991	Glasgow Jr., Murphy, Willingham and Rossini (1946)	−95°1	Timmermans, Van der Horst and Kamerlingh-Onnes (1922)
−95°01	Gibbons, Thompson, Reynolds, Wright, Chanan, Lamberti, Hipsher and Karabinos (1946)		

Constants of state: *Density*

t°	d		t°	d	
0	0.88545	B.E. (1926)	−22.9	0.90665	Massart (1936)
15	0.87160	„	0	0.88545	„
30	0.85770	„	34.50	0.85338	„
8.5	0.87757	Perkin (1896)	46.10	0.84265	„
15.0	0.8716	„	46.30	0.84250	„
20.0	0.8669	„	56.40	0.83280	„
25.0	0.8625	„	80.00	0.81017	„
30.0	0.8577	„	100.25	0.78963	„
0	0.885482	Batuecas and Casado (1938)	126.85	0.76217	„
			20	0.8669	Grosse and Wacklher (1939)
12.6	0.87319	Orton and Jones (1919)			
15	0.8716	Lumsden (1919)	20	0.8670	Gibbons, etc. (1946)
			20	0.86683	Forziati, Glasgow Jr.,
			25	0.86220	„ etc. (1946)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0.26	765.5	Thorpe and Rodger	15	623	B.E. (1926)
9.88	668.3	„ (1894)	30	523	„
19.47	590.0	„	20.6	583.0	Heydweiller (1896)
30.25	518.4	„	30	526	Puschin and Pinter (1929)
39.86	466.7	„			
49.43	421.9	„			

Surface tension

t°	γ	
15	29.10	Hennaut-Roland and Lek (1931)
20	28.52	„
30	27.40	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
8.5	—	1.49891	1.50349	—	—	1.51528	—	1.52523	Perkin (1900)
15	1.49471	1.49510	1.49985	1.50006	1.50927	1.51134	1.51870	1.52139	B.E. (1926)
$\frac{dn}{dt}$	0.00058	—	60	—	—	60	—	62	„
20	—	—	1.49682	—	—	—	—	—	Forziati, etc. (1946)
25	—	—	1.49405	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00055	—	—	—	—	—	„
20	—	—	1.4966	—	—	—	—	—	Fischer and Reichel (1943)
20	—	—	1.4967	—	—	—	—	—	Gibbons, etc. (1946)
20	—	—	1.49693	—	—	—	—	—	B.E. (1949)

Dielectric constant: Le Fevre (1938)

t°	ε	t°	ε	t°	ε
−50	2.5889	+25	2.3661	80	2.2449
−33	2.5336	45	2.3196	100	2.2061
−15	2.4785	60	2.2846	110	2.1901
0	2.4350				

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −168.91	0.1686	−120.44	0.1999	−50.02	0.3606	Southard and Andrews (1930)
−160.56	0.1727	−112.82	0.2076	−42.95	0.3630	
−151.19	0.1798	−105.81	0.2130	−35.58	0.3650	„
−143.16	0.1817	L. − 83.91	0.3519	−28.37	0.3704	„
−135.72	0.1888	− 55.99	0.3557			
−127.93	0.1953					
—	—	—	—	L. + 25	0.4059	Vold (1937)

Heat of vaporisation	25° 98.549 cal 15°/g	Osborne and Ginnings (1947)
Heat of combustion	25° (c_p) 10142.8 „	Prosen, Gilmont and Rossini (1945) (M. W. 92.134)
	25° (c_p) 10134.7 „	Coops, Mulder, Dienske and Smittenberg (1946) (M. W. 92.134)

ETHYLBENZENE $C_6H_5-C_2H_5$

The physical constants of ethylbenzene are reliable only when they apply to synthetic ethylbenzene. From this term onward, the homologous hydrocarbons are prepared by Würtz's method.

Constants: B.E. (1926)

Critical constants

t° cr.	d cr.	
344.0	0.2835	Simon (1938)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
0	1.125	8.47	3.460	17.20	6.017	Scott and Brickwedde
2.57	2.310	9.33	3.670	18.98	6.703	„ (1945)
4.54	2.640	10.48	3.944	19.19	6.786	„
6.37	3.015	14.23	5.005	21.45	7.772	„
6.50	3.024	16.42	5.754	23.45	8.739	„
78.93	121.2	102.93	284.15	127.30	596.5	Young and Fortey (1903)
79.52	123.95	105.98	313.65	130.32	648.6	„
81.60	134.3	109.11	346.9	132.24	684.8	„
84.74	150.65	112.13	381.0	134.36	724.4	„
87.80	168.15	115.12	417.45	135.62	750.2	„
90.87	188.05	118.08	456.8	137.43	786.8	„
93.96	209.45	121.06	499.3	139.44	829.1	„
96.86	231.85	124.25	546.6	141.29	871.5	„
99.90	257.15					„

Boiling point

136°1	Mathews (1926)	136°25	Gibbons, Thompson, Reynolds, Wright, Chanan, Lamberti, Hipsher and Karabinos (1946)
136°15	B.E. (1926) and Lecat (passim)		
136°18	Young and Fortey (1903)		

$\frac{dt}{dp}$ *(10 mm)*: 0°48 B.E. (1926) and Lecat.

Freezing point

$-94°950$	Streiff and Rossini (1944)	$-94°991$	Guthrie Jr., Spitzer and Huffman (1944)
$-94°950$	Glasgow Jr., Murphy, Willingham and Rossini (1946)	$-95°01$	Gibbons, etc. (1946)

Triple point: $-95°005$ Scott and Brickwedde (1945)

Constants of state

Density

t°	d		t°	d	
-83.6	0.95798	Massart (1936)	0	0.88452	B.E. (1926)
-45.2	0.92415	„	15	0.87130	„
-22.9	0.90464	„	30	0.85810	„
0	0.88458	„	0	0.88457	Young and Fortey (1903)
14.85	0.87152	„	8.4	0.87697	Perkin (1900)
26.90	0.86085	„	20	0.8671	Gibbons, etc. (1946)
45.50	0.84412	„	20.0	0.8672	Mathews (1926)
59.95	0.83138	„			
79.70	0.81373	„			
97.60	0.79695	„			
125.90	0.77016	„			

Viscosity	t°	$\eta \cdot 10^5$	
	15	697	B.E. (1926)
	30	581	„

Surface tension	t°	γ	
	15	29.75	Hennaut-Roland and Lek (1931)
	20	29.20	„
	30	28.14	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.49374	1.49408	1.49857	1.49868	1.50750	1.50950	1.51629	B.E. (1926)
$\frac{dn}{dt}$	0.00054	54	54	54	55	55	55	„
20	—	—	1.4958	—	—	—	—	Gibbons, etc. (1946)
20	—	—	1.49593	—	—	—	—	Mathews (1926)

Specific heat

t°	c_p	t°	c_p	
C. −259.82	0.009542	L. −91.65	0.35463	Guthrie Jr., Spitzer and Huff-
−253.44	0.02433	−64.35	0.36384	man (1944) (M. W. 106.160)
−240.88	0.05793	−52.02	0.36935	,,
−231.10	0.08019	−38.18	0.37668	,,
−220.88	0.098718	−28.46	0.38180	,,
−210.76	0.11470	−17.64	0.38852	,,
−202.02	0.12665	− 6.20	0.39578	,,
−189.97	0.14156	+ 4.25	0.40304	,,
−176.34	0.15653	13.73	0.40979	,,
−163.73	0.16318	23.07	0.41706	,,
−146.37	0.18707	32.25	0.42384	,,
−134.18	0.19991			,,
−122.69	0.21178			,,
−112.54	0.22303			,,
C. −258.16	0.0132	L. −95.005	0.3541	Scott and Brickwedde (1945)
−248.16	0.03849	−88.16	0.3557	,, (M.W. 106.16)
−238.16	0.06480	−78.16	0.3588	,,
−228.16	0.08608	−68.16	0.3624	
−218.16	0.1038	−58.16	0.3667	(other values, see authors)
−208.16	0.1186	−48.16	0.3715	,,
−198.16	0.1315	−38.16	0.3767	,,
−188.16	0.1438	−28.16	0.3825	,,
−178.16	0.1545	−18.16	0.3884	,,
−168.16	0.1648	− 8.16	0.3949	,,
−158.16	0.1751	+ 1.84	0.4018	,,
−148.16	0.1854	11.84	0.4090	,,
−138.16	0.1957	21.84	0.4164	,,
−128.16	0.2060	26.84	0.4205	,,
−118.16	0.2165			,,
−108.16	0.2268			,,
− 98.16	0.2370			,,
− 95.005	0.2403			,,

Heat of vaporisation	20°85	95.654	cal 15°/g	Scott and Brickwedde (1945)
	(B.P.)	81.08	,,	Mathews (1926)
Heat of combustion	25° (c_p)	10277.2	,,	Prosen, Gilmont and Rossini (1945) (M. W. 106.16)
	25° (c_p)	10266.9	,,	Coops, Mulder, Dienske and Smittenberg (1946) (M. W. 106.16)

n-PROPYLBENZENE $C_6H_5-n\text{-}C_3H_7$

Constants: B.E. (1930)

Boiling point

159°3	$\frac{dt}{dp}$ *(10 mm)* 0°52 Lecat (passim)	159°45	$\frac{dt}{dp}$ *(10 mm)* 0°52 B.E. (1930)
159°31	Gibbons, Thompson, Reynolds, Wright, Chanan, Lamberti, Hipsher and Karabinos (1946)		

Freezing point

−99°57	Gibbons, etc. (1946)
−99°585	Glasgow Jr., Murphy, Willingham and Rossini (1946)

Density

t°	d		t°	d	
−95.1	0.95737	Massart (1936)	4	0.8753	Perkin (1894)
−83.6	0.94830	„	5	0.8745	„
−45.2	0.91584	„	8.3	0.8719	„ (1900)
−22.9	0.89754	„	10	0.8702	„ (1896)
0	0.87864	„	15	0.86635	„ (1900)
15.15	0.86613	„	0	0.87864	B.E. (1930)
22.85	0.85966	„	15	0.86629	„
38.30	0.84691	„	30	0.85380	„
62.75	0.82642	„	20	0.8618	Gibbons, etc. (1946)
76.10	0.81482	„			
99.55	0.79423	„			
130.00	0.76608	„			

Viscosity	t°	$\eta \cdot 10^5$	
	15	917	B.E. (1930)
	30	746	„

Surface tension	t°	γ		t°	γ	
	15	29.52	B.E. (1930)	4.5	20.6	Schiff (1884)
	20	29.01	„			
	30	28.02	„			

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.48937	1.49016	1.49436	1.50242	1.50478	1.5111
$\frac{dn}{dt}$	0.00044	46	46	46	48	47

Heat of combustion	25° (c_p) 10376.9 cal 15°/g	Prosen, Gilmont and Rossini (1945) (M. W. 120.186)

Iso-PROPYLBENZENE $C_6H_5-CH(CH_3)_2$

Constants

Saturated vapour pressure: Willingham, Taylor, Pignocco and Rossini (1945)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
70.020	47.65	89.077	103.66	115.495	261.76	150.956	732.11
74.365	57.41	93.991	124.67	122.353	324.95	151.576	744.08
78.155	67.24	98.975	149.44	129.433	402.44	152.152	755.27
81.579	77.29	103.604	175.89	136.983	500.72	152.798	767.96
84.768	87.73	109.802	217.18	145.176	627.94	153.367	779.39

Boiling point

152°393	$\frac{dt}{dp}$ *(10 mm)* 0°5076	Forziati, Glasgow Jr., Willingham and Rossini (1945)
152°42		Gibbons, Thompson, Reynolds, Wright, Chanan, Lamberti, Hipsher and Karabinos (1946)

Freezing point

−96°02	Gibbons, etc., (1946)
−96°028	Glasgow Jr, Murphy, Willingham and Rossini (1946)

Density	t°	d	
	20	0.8619	Gibbons, etc. (1946)
	20	0.86175	Forziati, Glasgow Jr., Willingham and
	25	0.85748	,, Rossini (1946)

Refractive index	$n_D^{20°}$	1.4912	Gibbons, etc., (1946)
	$n_D^{20°}$	1.49125	Forziati, Glasgow Jr., etc. (1946)
	$n_D^{25°}$	1.48874	„

Heat of vaporisation	25° 89.769 cal 15°/g	Osborne and Ginnings (1947)
Heat of combustion	25° (c_p) 10371.5 „	Johnson, Prosen and Rossini (1945) (M. W. 120.186)

n-BUTYLBENZENE $C_6H_5-n\text{-}C_4H_9$

The values of B.E. (1926) should be replaced by the new values below (unpublished).

Constants

Critical constants

t° cr	d cr	
387.8	0.2697	Simon (1938)

Boiling point

183°10	$\frac{dt}{dp}$ *(10 mm)* 0°58	B.E. (unp.)
183°1		Lecat (passim)

Freezing point

−87°970	Streiff, Murphy, Cahill, Flanagan, Sedlak, Willingham and Rossini (1947)
−87°994	Glasgow Jr., Murphy, Willingham and Rossini (1946)

Density

t°	d	t°	d		t°	d	
−95.1	0.95132	−22°9	0.89440	MASSART (1936)	0	0.87609	B.E. (unp.)
−83.6	0.94226	0	0.87608	”	15	0.86415	”
−45.2	0.91210	+15.15	0.86391	”	30	0.85221	”

Viscosity

t°	$\eta \cdot 10^5$	
15	1114	B.E. (unp.)
30	892	”

Surface tension

t°	γ	
15	29.84	B.E. (unp.)
20	29.38	”
30	28.34	”

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	
15	1.48729	1.48792	1.49207	1.49985	1.50199	1.50811	B.E. (unp.)
$\frac{dn}{dt}$	0.00042	42	42	43	43	44	”

Heat of combustion	25° (c_p) 10457.3 cal 15°/g	PROSEN, JOHNSON and ROSSINI (1946) (M. W. 134.212)

Iso-BUTYLBENZENE	C_6H_5—$CH_2CH(CH_3)_2$
Sec. ”	C_6H_5—*sec.*-C_4H_9
Tert. ”	C_6H_5—*tert.*-C_4H_9

Freezing point: STREIFF, CAHILL, FLANAGAN, SEDLAK, WILLINGHAM and ROSSINI (1947).

Heat of combustion: PROSEN, JOHNSON and ROSSINI (1946).

For *sec*-BUTYLBENZENE: *density* and *refractive index:* CUYPERS (1939).

n-DODECYLBENZENE	C_6H_5—*n*-$C_{12}H_{25}$
n-TETRADECYLBENZENE	C_6H_5—*n*-$C_{14}H_{29}$.

Boiling, freezing and *critical solution points, density, viscosity* and *refractive index:* YU, WOOD and GARNER (1912) and YU, SHEN and WOOD (1940).

n-AMYLBENZENE $C_6H_5-n\text{-}C_5H_{11}$ (A) *n*-HEXYLBENZENE $C_6H_5-n\text{-}C_6H_{13}$ (B)

Constants: SIMON (1929)

	(A)			(B)		
Boiling point	205°3			227°35		
Freezing point	—78°25			—66°8		
Density 0°	0.87411			0.87527		
15°	0.86261			0.86394		
30°	0.85100			0.85259		
Viscosity $\cdot 10^5$ 15°	1487			1833		
30°	1126			1409		
Surface tension 15°	30.18			30.70		
20°	29.65			30.14		
30°	28.61			29.17		
Refractive index	15°	25°	$\frac{dn}{dt} \cdot 10^5$	15°	25°	$\frac{dn}{dt} \cdot 10^5$
He r.	1.48622	1.48196	43	1.48696	1.48297	40
Hα	1.48674	1.48240	43	1.48745	1.48341	40
D	1.49062	1.48633	43	1.49132	1.48718	41
He y.	1.49072	1.48643	43	1.49151	1.48736	41
He g.	1.49820	1.49390	43	1.49892	1.49468	42
Hβ	1.50006	1.49572	43	1.50092	1.49660	43
He v.	1.50597	1.50173	43	1.50705	1.50271	43
Hγ	1.50834	1.50394	44	1.50976	1.50547	43

POLYSUBSTITUTED HYDROCARBONS

THE XYLENES

The xylenes cannot easily be separated by distillation alone, owing to the proximity of their boiling points; the *para* compound is purified by crystallization and the *ortho* and *meta* compounds in the form of solid sulphonic derivatives.

Ortho-XYLENE $o\text{-}C_6H_4(CH_3)_2$

Constants. — Polyphasic equilibria

Critical constants

t° cr.	d cr.	
358.0	0.2877	SIMON (1938)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
12.5	3.00	50.0	25.50	—	—	Pitzer and Scott (1943)
25.0	6.60	60.0	40.60	—	—	,,
37.5	13.50	—	—	—	—	,,
63.460	47.66	91.987	149.44	137.346	627.93	Willingham, Taylor,
67.746	57.41	96.541	175.89	143.007	732.09	Pignocco and Rossini
71.481	67.23	102.632	217.17	143.614	744.06	,, (1945)
74.857	77.28	108.227	261.75	144.176	755.25	,,
77.993	87.75	114.965	324.94	144.809	767.95	,,
82.242	103.65	121.909	402.44	145.367	779.36	,,
87.081	124.67	129.318	500.71			,,

$$\log p\ \text{mm} = \frac{-2908.07}{T} - 5 \log T + 22.95279$$ Stuckey and Saylor (1940)

Boiling point

144°40	Stuckey and Saylor (1940)	144°412	Willingham, Taylor, Pignocco and Rossini (1945)
144°4	Brown (1905)		
144°41	Gibbons, Thompson, Reynolds Wright, Chanan, Lamberti, Hipsher and Karabinos (1946)	144°414	Forziati, Glasgow Jr., Willingham and Rossini (1946)
		144°466	Wojciechowski (1939)

$\frac{dt}{dp}$ *(10 mm)*

0°4969	Forziati, Glasgow Jr., etc. (1946)	0°498	Willingham, Taylor, etc. (1945)
0°497	Wojciechowski (1939)		

Freezing point

−25°175	Glasgow Jr., Murphy, Willingham and Rossini (1946)	−25°225	Forziati, Glasgow Jr., etc. (1946)
−25°190	Streiff and Rossini (1944)	−25°34	Pitzer and Scott (1943)
−25°22	Gibbons, etc. (1946)		

Melting curve

t°	p kg/cm^2	t°	p kg/cm^2	
−25.0	1	−10.0	654	Deffet (1935)
−20.0	220	− 5.0	865	,,
−15.0	437	0.00	1080	,,

Constants of state

Density

t°	d		t°	d	
−22.95	0.91595	Massart (1936)	0	0.89692	B.E. (unp.)
0	0.89692	,,	15	0.88428	,,
15.00	0.88425	,,	30	0.87160	,,
29.70	0.87180	,,	0	0.89683	Miller (1932)
46.40	0.85765	,,	20	0.88010	,,
60.47	0.84558	,,	19.12	0.880776	Patterson (1902)
79.45	0.82945	,,	22.44	0.877938	,,
106.05	0.80573	,,	28.93	0.872521	,,
15.5	0.8837	Auwers (1919)	36.34	0.866286	,,
20	0.8798	Gibbons, etc. (1946)	20	0.88005	Forziati, Glasgow Jr.,
20	0.8800	Brühl (1894)	25	0.87583	,, etc. (1946)
24.1	0.8758	Gladstone (1891)			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	866	B.E. (unp.)	65.92	470	Thorpe and Rodger
30	693	,,	77.48	420	,, (1894)
			78.78	416	,,
0.35	1097	Thorpe and Rodger	90.37	374	,,
0.49	1093	,, (1894)	90.82	373	,,
13.00	894	,,	100.71	343	,,
13.88	881	,,	101.78	340	,,
26.54	738	,,	115.65	303	,,
26.88	735	,,	116.61	302	,,
39.33	628	,,	128.15	276	,,
51.15	549	,,	128.69	275	,,
51.94	544	,,	139.89	254	,,
65.4	473	,,	141.14	252	,,

Surface tension

t°	γ		t°	γ	
15	30.75	B.E. (unp.)	17.2	30.41	Kremann and Meingast
20	30.10	,,	20.0	30.17	,, (1914)
30	29.08	,,	26.0	29.65	,,
20.0	30.1	Smith (1944)	37.2	28.40	,,
			47.0	27.52	,,
			56.5	26.76	,,
			61.7	26.22	,,
			70.0	25.42	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.50263	1.50328	—	1.50796	1.51708	1.51946	1.52654	—	B.E. (unp.)
$\frac{dn}{dt}$	0.00047	48	—	49	50	52	52	—	„
9.26	—	1.50632	1.51086	—	—	—	—	1.53221	Miller (1932)
16.54	—	1.50273	1.50721	—	—	—	—	1.52847	„
$\frac{dn}{dt}$	—	0.00049	50	—	—	—	—	51	„
20	—	—	1.50524	—	—	—	—	—	Forziati, etc.
25	—	—	1.50282	—	—	—	—	—	„ (1946)
$\frac{dn}{dt}$	—	—	0.000484	—	—	—	—	—	„
20	—	—	1.5052	—	—	—	—	—	Gibbons, etc. (1946)
21.6	—	1.50021	1.50463	—	—	1.51602	—	1.52578	Brühl (1894)

Heat constants

Heat of melting	30.64 cal 15°/g	Pitzer and Scott (1943)
	31.4 „	Rossini (1933)
Heat of combustion	25° (c_p) 10250.2 cal 15°/g	Prosen, Gilmont and Rossini (1945) (M.W. 106.16)
	25° (c_p) 10243.0 „	Coops, Mulder, Dienske and Smittenberg (1946) (M.W. 106.16)

Meta-XYLENE $m\text{-}C_6H_4(CH_3)_2$

Constants: B.E. (1930)

Critical constants

t° cr.	d cr.	
343.6	0.2822	Simon (1938)

Boiling point

139°091	$\frac{dt}{dp}$ *(10 mm)* 0°491 Wojciechowski (1939)	139°2	Lecat (passim)
139°15	(B.E.'s sample) White and Rose (1932)	139°30	$\frac{dt}{dp}$ *(10 mm)* 0°49 B.E. (1930)
		139°3	Perkin (1896–1900)

Freezing point

−47°872	Glasgow Jr., Murphy, Willingham and Rossini (1946)	−47°89	White and Rose (1932)
−47°890	Streiff and Rossini (1944)	−48°05	White and Rose (1932) (B.E.'s sample)

Density

t°	d		t°	d	
0	0.88113	Massart (1936)	0	0.88113	B.E. (1930)
14.90	0.86848	„	15	0.86835	„
25.15	0.85958	„	30	0.85551	„
46.00	0.84140	„	4	0.8779	Perkin (1896)
61.15	0.82860	„	5	0.8770	„
100.00	0.79476	„	8.4	0.87397	„ (1900)
20	0.86412	White and Rose (1932)	10	0.8726	„ (1896)
27	0.85817	„	15	0.8683	„
20	0.86416	„ (B.E.'s sample)	20	0.8640	„
27	0.85821	„	25	0.8600	„

Viscosity	t°	$\eta \cdot 10^5$	
	15	650	B.E. (1930)
	30	547	„

Surface tension	t°	γ	
	15	29.15	Hennaut-Roland and Lek (1931)
	20	28.63	„
	30	27.56	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.49454	1.49527	—	1.49989	1.50889	1.51108	1.51811	—	B.E. (1930)
$\frac{dn}{dt}$	0.00047	48	—	—	48	49	49	—	„
8.4	—	1.49878	1.50324	—	—	1.51469	—	1.52462	Perkin (1900)
25	—	—	1.49467	—	—	—	—	—	White and Rose (1932) (B.E.'s sample)

Heat of melting	26.01 cal 15°/g	Rossini (1933)
Heat of combustion	25° (c_p) 10247.9 „	Prosen, Gilmont and Rossini (1945) (M.W. 106.16)
	25° (c_p) 10238.7 „	Coops, Mulder, Dienske and Smittenberg (1946) (M.W. 106.16)

Para-XYLENE $p\text{-}C_6H_4(CH_3)_2$

The best criterion of purity is the constancy of the melting point.

Constants: B.E. (1926). — **Polyphasic equilibria**

Critical constants

t° cr.	d cr.	
342.75	0.2807	Simon (1938)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
0	1.35 (S.)	25.0	8.90 (L.)	50.0	32.60	Pitzer and Scott
12.5	4.05 „	37.5	17.50	60.0	51.35	„ (1943)
58.288	47.66	86.488	149.45	131.355	627.93	Willingham, Taylor, Pignocco and Rossini
62.523	57.43	90.990	175.92	136.956	732.10	„ (1946)
66.216	67.25	97.013	217.19	137.558	744.07	„
69.549	77.30	102.546	261.78	138.114	755.27	„
72.657	87.73	109.211	324.97	138.742	768.00	„
76.852	103.67	116.083	402.45	139.289	779.36	„
81.636	124.68	123.409	500.71			„

Boiling point

138°348	Forziati ,Glasgow Jr., Willingham and Rossini (1946)	138°40	B.E. (1926)
		138°40	Miller (1932)
138°348	Willingham, Taylor, etc. (1946)	138°4	White and Rose (1932)
138°36	Gibbons, Thompson, Reynolds, Wright, Chanan, Lamberti, Hipsher and Karabinos (1946)	138°43	Neubeck (1887)
		138°44	Wojciechowski (1939)
		138°45	Lecat (passim)

$\frac{dt}{dp}$ *(10 mm)*

0°491	Wojciechowski (1939)	0°493	Willingham, Taylor, etc. (1943)
0°4918	Forziati, Glasgow Jr., etc.(1946)		

Melting point

13°20	Swietoslawski (1943)	13°260	Streiff and Rossini (1944)
13°2	Huffman, Parks and Daniels (1930)	13°263	Forziati, Glasgow Jr., etc.(1946)
		13°28	Gibbons, etc., (1946)
13°21	White and Rose (1932)	13°30	Miller (1932)
13°23	Pitzer and Scott (1943)	13°35	B.E. (1926) and Deffet (1935)
13°239	Glasgow Jr., Murphy, Willingham and Rossini (1946)	13°4	Perkin (1900)
		13°4	Swallow and Gibson (1934)

Melting curve

t°	p kg/cm²	t°	p kg/cm²	
13.35	1	30.00	495	Deffet (1935)
15.00	49	35.00	647	„
20.00	197	40.00	803	„
25.00	343	45.00	957	„
13.4	1	49.0	1110	Swallow and Gibson (1934)
20.0	215	60.6	1470	„
35.0	670	65.0	1625	„
41.7	870	80.0	2130	„

Constants of state

Density

t°	d		t°	d	
14.90	0.86544	Massart (1936)	15	0.86535	B.E. (1926)
25.12	0.85652	„	30	0.85230	„
46.00	0.83851	„	15	0.8654	Perkin (1896)
60.60	0.82564	„	17.2	0.8635	Eykman (1911)
61.05	0.82527	„	19.5	0.86134	Patterson (1902)
79.70	0.80866	„	20	0.86094	Miller (1932)
100.00	0.78998	„	20	0.8608	Gibbons, etc., (1946)
			20.0	0.8611	Perkin (1896)
20	0.86100	Forziati, Glasgow, Jr.,	25.5	0.85613	Patterson (1902)
25	0.85666	„ etc. (1946)	33.3	0.84934	„
25	0.8567	Williams and Krchma (1927)	40.65	0.84294	„
			27	0.85498	White and Rose (1932)
			27	0.85509	„ (B.E.'s sample)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
8.31	751.3	77.38	350.32	Thorpe and Rodger (1894–95)
20.52	638.7	88.88	319.7	„
31.20	561.1	100.81	290.3	„
41.92	487.5	111.76	266.5	„
53.61	441.0	123.83	244.7	„
68.42	395.8	135.19	224.9	„
15	682	30	568	B.E. (1926)

Surface tension

t°	γ	
15	28.91	Hennaut-Roland and Lek (1931)
20	28.36	„
30	27.29	„
20	28.5	Smith (1944)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.49348	1.49420	—	1.49873	1.50771	1.51000	1.51703	1.51985	B.E. (1926)
$\frac{dn}{dt}$	—	0.00048	—	—	—	50	—	50	„
17.2	1.49264	1.49327	—	1.49782	1.50680	1.50903	1.51597	1.51882	Eykman 1911)
20	—	—	1.4958	—	—	—	—	—	Gibbons, etc. (1946)
20	—	—	1.49580	—	—	—	—	—	Forziati, Glasgow, Jr. etc. (1946)
25	—	—	1.49319	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00052	—	—	—	—	—	„
25	—	—	1.49320 (B.E.'s sample)	—	—	—	—	—	White and Rose (1932)

White and Rose (1932) found a difference of 0.0005 for the refractive index, using the sample of B.E.

Dielectric constant: 20° 2.273 PIETTE (unp.)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −181.36	0.159	−139.16	0.204	−47.86	0.290	HUFFMAN, PARKS and DANIELS
−177.96	0.163	−120.86	0.221	−28.06	0.308	
−172.16	0.170	− 98.46	0.241	−17.76	0.318	„ (1930)
−166.36	0.176	− 88.86	0.250	− 7.06	0.329	„
−159.36	0.184	− 68.06	0.271			
−257.40	0.01141	−198.76	0.1363	−93.61	0.2469	PITZER and SCOTT
−255.74	0.01497	−192.86	0.1445	−83.30	0.2560	„ (1943)
−253.84	0.01922	−186.21	0.1539	−73.01	0.2659	„
−251.36	0.02521	−178.84	0.1627	−62.05	0.2751	„
−247.18	0.03591	−170.89	0.1719	−48.26	0.2888	„
−239.58	0.05801	−162.44	0.1807	−36.91	0.3006	„
−233.43	0.07251	−153.52	0.1908	−32.47	0.3043	„
−229.30	0.08232	−144.15	0.2003	−25.68	0.3123	„
−224.54	0.09216	−134.51	0.2097	−18.31	0.3199	„
−219.48	0.1026	−124.47	0.2189	−12.06	0.3267	„
−213.60	0.1130	−114.12	0.2283	−10.27	0.3274	„
−206.39	0.1246	−103.48	0.2379			„
C. 0	0.3934	100	0.4686	220	0.5801	CORRUCCINI and
13.2	0.4013	120	0.4864	240	0.6029	GINNINGS (1947)
L. 20	0.4057	140	0.5043	260	0.6285	„
40	0.4198	160	0.5223	280	0.6573	„
60	0.4350	180	0.5406	300	0.6893	„
80	0.4513	200	0.5596			„

Heat of vaporisation	25°	95.307 cal 15°/g	PITZER and SCOTT (1943)
Heat of melting		38.12 „	HUFFMAN, PARKS and DANIELS (1930)
		38.55 „	PITZER and SCOTT (1943)
	0°	37.83 „	CORRUCCINI and GINNINGS (1947)
Heat of combustion	25° (c_p)	10250.2 „	PROSEN, GILMONT and ROSSINI (1945) (M.W. 106.16)
	25° (c_p)	10242.9 „	COOPS, MULDER, DIENSKE and SMITTENBERG (1946) (M.W. 106.16)

Pseudo-CUMENE or 1,2,4-TRIMETHYLBENZENE $C_6H_3(CH_3)_3$

Constants

Saturated vapour pressure: $\log p\,(\text{mm}) = -(2432.42/T) + 8.437$ HOPKE and SEARS (1948)

Boiling point: 169°18 MAIR and SCHICKTANZ (1933)

Melting point

−43°913	GLASGOW Jr., MURPHY, WILLINGHAM and ROSSINI (1946)	−44°09	MAIR and SCHICKTANZ (1933)
		−44°1	ROSSINI (1933)

Density: 20° 0.87623 MAIR and SCHICKTANZ (1933)

Refractive index: $n_D^{25°}$ 1.5025 MAIR and SCHICKTANZ (1933)

Specific heat

t°	c_p	t°	c_p	
C. −179.46	0.158	L. −33.66	0.388	HUFFMAN, PARKS and BARMORE (1931)
−173.16	0.166	−26.26	0.392	„
−158.06	0.185	−12.66	0.400	„
−149.46	0.195	+ 3.84	0.412	„
−132.36	0.214	10.44	0.415	„
−110.16	0.240	24.14	0.422	„
− 92.46	0.259			„

Heat of vaporisation	25° 95.324 cal 15°/g	OSBORNE and GINNINGS (1947)
Heat of melting	22.9 „	ROSSINI (1933)
Heat of combustion	25° (c_p) 10330.5 „	JOHNSON, PROSEN and ROSSINI (1945) (M.W. 120.186)

MESITYLENE or 1,3,5-TRIMETHYLBENZENE $C_6H_3(CH_3)_3$

Constants

Saturated vapour pressure from −18° to −5°: $\log p\,(\text{mm}) = -(2667.51/T) + 9.394$ HOPKE and SEARS (1948)

Boiling point: 164°64 MAIR and SCHICKTANZ (1933)

Melting point

−44°720	STREIFF, MURPHY, SEDLAK, WILLINGHAM and ROSSINI (1946)	α −44°78	MAIR and SCHICKTANZ (1933)
		β −51°74	„
		α −44°8	ROSSINI (1933)
−44°738	GLASGOW Jr., MURPHY, WILLINGHAM and ROSSINI (1946)	β −51°7	„

Density: 20° 0.86513 Mair and Schicktanz (1933)

Refractive index: $n_D^{25°}$ 1.4967 Mair and Schicktanz (1933)

Heat of vaporisation	25°	94.401 cal 15°/g	Osborne and Ginnings (1947)
Heat of melting		α 18.90 „	Rossini (1933)
		β 15.94 „	„
Heat of combustion	25° (c_p)	10327.2 „	Johnson, Prosen and Rossini (1945) (M.W. 120.186)

HEMIMELLITENE or 1,2,3-TRIMETHYLBENZENE $C_6H_3(CH_3)_3$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
40.8	2.25	77.6	31.5	133.3	243.0	Smith and Spillane (1940)
45.25	4.0	86.25	47.5	141.3	307.5	„
47.8	5.0	92.8	56.25	151.06	405.5	„
50.3	6.0	102.10	80.0	157.24	481.5	„
51.8	6.75	109.3	106.0	162.2	546.0	„
56.25	9.2	113.0	123.0	165.66	591.5	„
58.2	10.5	117.14	140.5	168.21	639.0	„
65.7	16.5	122.3	166.5	170.46	676.5	„
71.75	22.0	127.76	196.5			„

From − 14° to −3°: $\log p\,(\text{mm}) = -(2219.69/T) + 7.508$ Hopke and Sears (1948)

Boiling point: 176°10 Mair and Schicktanz (1933)

Melting point

−25°41	Smith and Spillane (1940)	−25°494	Glasgow Jr., Murphy, Willingham and Rossini (1946)
−25°47	Mair and Schicktanz (1933)		

Density *Refractive index*

t°	d	t°	n_D	$\frac{dn}{dt}$	
0	0.9101	5	1.5209	0.00048	Smith and Spillane (1940)
20	0.8944	10	1.5185	0.00050	„
25	0.8906	15	1.5160	0.0006	„
30	0.8866	20	1.5130	0.0004	„
		25	1.5110	0.0004	„
		30	1.5090		„

Heat of vaporisation	25° 97.557 cal 15°/g	**Osborne** and **Ginnings** (1947)
Heat of melting	16.65 „	**Rossini** (1933)
Heat of combustion	25° (c_p) 10336.9 „	**Johnson, Prosen** and **Rossini** (1945) (M.W. 120.186)

DURENE or 1,2,4,5-TETRAMETHYLBENZENE and
Iso-DURENE or 1,2,3,5-TETRAMETHYLBENZENE $C_6H_2(CH_3)_4$

Boiling point and *saturated vapour pressure* **McDougall** and **Smith** (1930)

Melting point **Smith** and **McDougall** (1929)

Melting point and *specific heat* **Huffman, Parks** and **Barmore** (1931)

Melting point and *refractive index* **Smith** and **Cass** (1932)

PREHNITENE or 1,2,3,4-TETRAMETHYLBENZENE $C_6H_2(CH_3)_4$

Boiling point **McDougall** and **Smith** (1930)

Boiling and *melting points, density* and *refractive index* **Mair** and **Streiff** (1941)

Specific heat **Huffman, Parks** and **Barmore** (1931)

PENTAMETHYLBENZENE $C_6H(CH_3)_5$

Constants

Melting point

54°3	**Ferry** and **Thomas** (1933)
54°3	**Parks, West, Naylor, Fujii** and **Mc Claine** (1946)

Specific heat

t°	c_p	t°	c_p	t°	c_p	
L. 60	0.457	90	0.478	110	0.494	**Ferry** and **Thomas** (1933)
70	0.464	100	0.485	120	0.504	„
80	0.471					„

Heat of combustion	25° (c_p) 10447.2 cal 15°/g	**Parks, West**, etc. (1946) (M. W. 148.238)

HEXAMETHYLBENZENE $C_6(CH_3)_6$

Constants

Melting point

165°5 165°5	Van de Vloed (1938) Parks, West, Naylor, Fujii and Mc Claine (1946)	165°6	Spaght, Thomas and Parks (1932)

Transition point: 110°6 Spaght, Thomas and Parks (1932)

Specific heat

t°	c_p	t°	c_p	
C. 30	0.380	120	0.466	Spaght, Thomas and Parks (1932)
40	0.393	130	0.480	„
50	0.407	140	0.493	„
60	0.420	150	0.507	„
70	0.434	L. 170	0.555	„
80	0.448	180	0.566	„
90	0.463	190	0.576	„
100	0.478	200	0.587	„

Heat of combustion	25° (c_p) 10503.2 cal 15°/g	Parks, West, etc. (1946) (M. W. 162.264)

DI-*iso*-PROPYLBENZENES *ortho*, *meta* and *para* $C_6H_4(C_3H_7)_2$-*iso*

Saturated vapour pressure, boiling point, density and *refractive index* Melpolder, Woodbridge and Headington (1948)

Prosen, Johnson and Rossini (1946) give the heat of combustion of a series of alkylbenzenes.

Smith and Guss (1940) have studied the tetraethylbenzenes.

Gibbons, Thompson, Reynolds, Wright, Chanan, Lamberti, Hipsher and Karabinos (1946) have studied a series of diethylbenzenes; Fenske, Braun, Wiegand, Quiggle, Mc Cormick and Rank (1947), the 1 methyl, 2 and 3 *iso*propylbenzenes and the 1,3 dimethyl, 4 and 5 ethylbenzenes; Serijan, Hipsher and Gibbons (1949), the *o-m-p. tert.* butyltoluenes.

F. POLYCYCLIC AROMATIC HYDROCARBONS

Almost all these hydrocarbons are solid at room temperature. The data of the literature concerning the density and the refractive index, in the melted state are often mutually incompatible.

BIPHENYL $(C_6H_5)_2$

Constants

Critical constants

t° cr.	p cr. mm	d cr.	
528°	31400	0.343	Cork (1930)

Boiling point: 256°1 Lecat (passim)

Melting point

70°2	Eykman (1889)	70°5	Schiff (1884)
70°4	Cork (1930)	70°5	Lautsch (1928)
70°5	Efremow (1918)		

Specific heat

t°	c_p	t°	c_p	t°	c_p	
L. 77.6	0.408	136.55	0.457	164.7	0.499	Newton, Kauwra and De Vries (1931)
88.4	0.418	150.0	0.468	165.5	0.513	
126.2	0.446	157.8	0.478			,,

DIPHENYLMETHANE $C_6H_5-CH_2-C_6H_5$

Constants

Saturated vapour pressure: Crafts (1915)

t°	p mm	t°	p mm	t°	p mm
217.54	242.49	261.82	722.03	267.04	797.33
231.82	360.75	262.83	726.29	271.70	888.80
260.15	696.53	265.09	766.86	282.24	1101.79

Boiling point *Melting point*

264°7	**Perkin** (1896)	26°3	**Eykman** (1889)
264°72	**Crafts** (1915)	26°4	**Anderlini** (1895)
265°4	**Lecat** (passim)	26°5	**Schmidlin** (1903)
		26°6	**Efremow** (1918)

Heat of combustion	25° (c_p) 9841.5 cal 15°/g	**Coops, Mulder, Dienske** and **Smittenberg** (1946) (M.W. 168.226)

TRIPHENYLMETHANE $(C_6H_5)_3CH$

Constants

Melting point

93°	**Schmidlin** (1903)	93°1	**Smith** and **Andrews** (1931)
93°	**Anderlini** (1895)	93°2	**Morris** and **Cook** (1935)

Specific heat: **Smith** and **Andrews** (1931)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −171.26	0.111	−88.76	0.178	−27.16	0.234	25.34	0.287
−147.06	0.131	−72.06	0.193	−13.36	0.247	37.54	0.304
−125.76	0.147	−56.36	0.207	− 0.06	0.261	61.24	0.329
−106.46	0.163	−41.46	0.221	+12.84	0.274	72.54	0.339

Heat of combustion	25° (c_p) 9714.8 cal 15°/g	**Coops, Mulder, Dienske** and **Smittenberg** (1946) (M.W. 244.318)
	25° (c_p) 9709.6 „	**Parks, West, Naylor, Fujii** and **Mc Claine** (1946) (M.W. 244.318)

TETRAPHENYLMETHANE $(C_6H_5)_4C$

Constants

Melting point: 283° **Smith** and **Andrews** (1931)

Specific heat „

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −171.26	0.106	−88.76	0.171	−27.16	0.223	25.34	0.272
−147.06	0.123	−72.06	0.185	−13.36	0.235	37.54	0.288
−125.76	0.140	−56.36	0.197	− 0.06	0.249	61.24	0.313
−106.46	0.155	−41.46	0.211	+12.84	0.262	72.54	0.324

Heat of combustion	25° (c_p) 9651.1 cal 15°/g	**Coops, Mulder, Dienske** and **Smittenberg** (1946) (M.W. 320.41)

1,2-DIPHENYLETHANE or BIBENZYL $C_6H_5-CH_2-CH_2-C_6H_5$

Constants

Melting point

51°8	Bogojawlensky and Winogradow (1908)	51°8 52°00	Efremow (1918) Deffet (1940)

Melting curve

t°	p kg/cm²	t°	p kg/cm²	
52.00	1	70.00	624	Deffet (1940)
55.00	102	75.00	801	„
60.00	278	80.00	970	„
65.00	448			„

Heat of combustion	25° (c_p) 9909.9 cal 15°/g	Coops, Mulder, Dienske and Smittenberg (1946) (M.W. 182.252)
	25° (c_p) 9906.5 „	Parks, West, Naylor, Fujii and Mc Claine (1946) (M.W. 182.252)

OTHER PHENYLETHANES $(C_6H_5)_2CH-CH_3$; $(C_6H_5)_3C-CH_3$; $(C_6H_5)_2CH-CH_2(C_6H_5)$; $(C_6H_5)_3C-CH_2(C_6H_5)$; $(C_6H_5)_2CH-CH(C_6H_5)_2$; $(C_6H_5)_3C-CH(C_6H_5)_2$
Melting point and *specific heat* Smith and Andrews (1931)
Heat of combustion Coops, Mulder, Dienske and Smittenberg (1946).

1,2-DIPHENYLETHYLENE or STILBENE $C_6H_5-CH=CH-C_6H_5$ *(trans)*

Constants

Melting point

124°2	Parks and Huffman (1930)	124°4	Ferry and Thomas (1933)

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −180.86	0.116	−124.86	0.159	−18.76	0.262	Parks and Huffman
−179.26	0.118	−108.26	0.174	− 8.26	0.273	„ (1930)
−171.46	0.123	− 93.56	0.188	+ 3.24	0.284	„
−163.36	0.129	− 74.36	0.206	19.64	0.301	„
−148.86	0.140	− 61.46	0.219			„
−139.16	0.148	− 45.56	0.235			„

Specific heat (continued)

t°	c_p	t°	c_p	t°	c_p	
40	0.317	70	0.349	100	0.381	Ferry and Thomas
50	0.328	80	0.360	110	0.391	„ (1933)
60	0.338	90	0.370	130	0.466	„

Heat of combustion	25° (c_v) 9748.2 cal 15°/g 25° (c_p) 9758.1 „	Richardson and Parks (1939) „ (M.W. 180.24)

OTHER PHENYLETHYLENES AND DIPHENYLACETYLENE

$(C_6H_5)_2C{=}CH(C_6H_5)$; $(C_6H_5)_2C{=}C(C_6H_5)_2$; $(C_6H_5)C{\equiv}C(C_6H_5)$

Melting point and *specific heat:* Smith and Andrews (1931)

G. CONDENSED POLYCYCLIC AROMATIC HYDROCARBONS

NAPHTHALENE $C_{10}H_8$

Purified by distillation and fractional crystallization from acetone. Burriel (1930)
Note on the stability of naphthalene. Crafts (1913)

Constants. — Polyphasic equilibria

Critical density: 0.314 Schröer (1941)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
C. 10.00	0.0174	20.00	0.0648	30.00	0.177	Swan and Mack (1925)
C. 30	0.12	50	0.82	60	1.86	Winstrom and Kulp
40	0.33					„ (1949)
L. 98.3	18.0	125.8	53.6	148.1	116.0	Stelzner (1901)
105.0	23.9	133.4	70.0	159.1	168.5	„
112.8	32.5	141.0	90.4	165.1	207.1	„
214.361	699.26	217.883	758.81	219.819	792.79	Finck and Wilhelm
214.487	702.38	217.873	758.92	219.920	794.47	„ (1925)
214.573	703.68	217.904	759.69	220.052	796.97	„
214.918	709.54	217.930	760.21	220.201	799.44	„
217.785	757.32	217.966	792.79			„

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
87.47	11.9	144.45	103.5	198.53	482.1	**Nelson** and **Senseman**
95.00	15.5	158.95	165.1	200.50	505.7	„ (1922)
100.00	18.5	163.13	187.1	205.78	576.2	„
104.39	22.9	175.10	260.8	206.00	581.9	„
109.65	28.7	178.44	290.0	212.17	667.8	„
114.70	35.9	181.20	310.6	213.30	682.7	„
117.15	38.3	185.33	347.6	217.34	755.8	„
128.06	58.7	188.30	376.5	217.87	759.2	„
133.72	71.2	196.96	464.1	221.45	825.2	„

t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²	
327.5	7.5	423	23.70	463.5	35.40	**Schröer** (1941)
349	10.10	426	24.50	467	36.90	„
361	11.90	431.5	25.50	472	38.65	„
375	15.20	438	27.30	476	40.40	„
389	16.30	448	30.50	477.5	41.15	„
400.5	18.75	454.5	32.30	478.5	41.25	„
414.5	21.45	459.5	34.00			„

19° → 35°: $\log p\,\mathrm{mm} = -[108.30/(t° + 27]) + 1.115$. **Sears** and **Hopke** (1949)

Boiling point

217°9	**Blacet**, **Leighton** and **Bartlett** (1931)	217°96	**Waidner**, **Mueller** and **Foote** (1920) (corr. 217°98 **Waidner** and **Burgess** (1911))
217°94	**Callendar** and **Griffiths** (1891)		
217°95	**Nelson** and **Senseman** (1922)	217°96	**Holborn** and **Henning** (1911)
217°95	**Finck** and **Wilhelm** (1925)	217°96	**Mair** and **Streiff** (1940)
		218°0	**Lecat** (passim)

$\frac{dt}{dp}$ *(10 mm)*

0°58	**Finck** and **Wilhelm** (1925)	0°58	**Waidner**, **Mueller** and **Foote** (1920)

Melting point:

80°10	**Francis** and **Collins** (1936)	80°25	**Lee Ward** (1934)
80°12	**Sunier** (1931)	80°25	**Briscoe** and **Rinchart** (1942)
80°21	**De Beule** (1931)	80°27	**Mair** and **Streiff** (1910)
80°2	**Winstrom** and **Kulp** (1949)		

Constants of state

Density (from 80° to 476°5): Jouravlev (1937)

t°	d	
L. 85°	0.9752	Mair and Streiff (1940)
C. 30	1.01813	Cohen, de Meester and Moesveld (1924)

Density and *surface tension* (L.): Campbell and Campbell (1941)
Viscosity from 89° to 176°0: Golik and Ravikovitch (1949)
Refractive index: $n_D^{85°}$ 1.5898 Mair and Streiff (1940)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
−258.02	0.01102	−183.30	0.1049	−80.47	0.1925	Southard and Brickwedde (1933)
−255.43	0.01589	−180.10	0.1071	−75.54	0.1965	
−251.71	0.02314	−177.77	0.1082	−70.31	0.2018	,,
−250.91	0.02564	−172.39	0.1129	−65.16	0.2071	,,
−247.62	0.03169	−167.12	0.1160	−60.06	0.2123	,,
−246.50	0.03387	−161.98	0.1201	−55.03	0.2175	,,
−243.37	0.03962	−156.95	0.1238	−50.06	0.2227	,,
−241.42	0.04300	−152.05	0.1277	−46.26	0.2271	,,
−238.81	0.04738	−147.22	0.1322	−45.15	0.2284	,,
−236.69	0.05086	−142.48	0.1361	−40.21	0.2330	,,
−233.82	0.05496	−137.81	0.1400	−35.38	0.2377	,,
−231.86	0.05774	−132.83	0.1441	−34.22	0.2394	,,
−228.52	0.06181	−127.55	0.1487	−30.62	0.2443	,,
−226.63	0.06420	−122.36	0.1536	−28.33	0.2465	,,
−222.93	0.06817	−121.17	0.1544	−22.48	0.2529	,,
−221.21	0.07083	−117.23	0.1577	−16.74	0.2595	,,
−215.79	0.07713	−112.14	0.1623	−11.07	0.2663	,,
−210.84	0.08215	−109.68	0.1642	− 5.46	0.2731	,,
−210.64	0.08230	−107.16	0.1666	+ 0.05	0.2800	,,
−205.30	0.08668	−104.64	0.1682	5.53	0.2870	,,
−199.80	0.09128	− 99.67	0.1730	10.93	0.2940	,,
−194.58	0.09573	− 94.77	0.1776	16.26	0.3009	,,
−189.59	0.1009	− 89.93	0.1824	21.52	0.3088	,,
−184.78	0.1038	− 85.17	0.1869			,,
−198.16	0.0937			Anderson and Stegeman (1941)		
− 38.16	0.2350			,,		
+ 16.84	0.2998	(diag. see author)		,,		

Heat of melting	50°	34.47 cal 15°/g	Lee Ward (1934)
	70°	34.94 ,,	,,
	80°	35.06 ,,	,,
Heat of combustion	20°(c_v)	9603 cal 15°/g	Keffler (1931)

METHYLNAPHTHALENES $C_{10}H_7CH_3$

Constants

	1-METHYL	2-METHYL	
Boiling point	244°78	241°14	MAIR and STREIFF (1940)
Melting point	—	−34°1	HUFFMAN, PARKS and BARMORE (1931)
	−30°77	−34°44	MAIR and STREIFF (1940)
Density	25° 1.0163	40° 0.99045	„
Refractive index	25°	40°	
Hα	1.60677	1.59407	„
D	1.61494	1.60192	„
Hβ	1.63672	1.62306	„

2-METHYLNAPHTHALENE — **Heat constants.**

Specific heat: HUFFMAN, PARKS and BARMORE (1931)

t°	c_p	t°	c_p	t°	c_p
C. −179.36	0.121	−116.06	0.175	−19.86	0.268
−166.06	0.133	− 76.56	0.210	− 0.76	0.299
−137.66	0.157	− 47.96	0.238	L. +37.24	0.383

Heat of melting	20.11 cal 15°/g	HUFFMAN, PARKS and BARMORE (1931)
Heat of combustion	25° (c_p) 9732.82 „	RICHARDSON and PARKS (1939)

1 and 2 ETHYLNAPHTHALENES $C_{10}H_7.C_2H_5$

1 and 2 *Iso*-PROPYLNAPHTHALENES $C_{10}H_7.CH(CH_3)_2$

Saturated vapour pressure, boiling point, density and *refractive index:* **KUTZ, NICKELS, MC GOVERN and CORSON (1948)**

ANTHRACENE $C_{14}H_{10}$

BURRIEL's sample was 99.9 % pure, after seven washings and two sublimations; it was further purified by recrystallization from C_6H_6.

Note on purification: DERNER and KING (1941)

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
162.5	6.1	192.1	18.2	231.0	59.9	STELZNER (1901)
169.3	8.1	205.3	28.2	245.3	88.5	,,
175.8	10.1	216.3	39.4	256.2	116.6	,,
181.2	12.4	221.3	45.0	265.3	145.7	,,
186.7	15.0	225.1	50.1			,,
220	42.6	255	113.5	285	237.2	NELSON and SENSEMAN
225	49.5	260	129.1	290	265.9	,, (1922)
230	57.3	265	146.5	295	297.5	,,
235	66.1	270	165.8	300	332.0	,,
240	76.0	275	187.3	305	369.5	,,
245	87.1	280	211.0	310	410.5	,,
250	99.6					,,

105° → 125°: $\log p\,\text{mm} = -\dfrac{5102.0}{T} + 12.002$. SEARS and HOPKE (1949)

Boiling point

339°77	BURGSTALLER (1912)	339°9	BURRIEL (1930)

Melting point

216°18	BURRIEL (1930)	217°	DERNER and KING (1941)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
222.3	691	251.0	519	285.0	449	GOLIK and RAVIKOVITCH
231.25	614	260.0	486	300.1	429	,, (1949)
240.9	547	279.0	468			,,

Heat of combustion	25° (c_v) 9451.0 cal 15°/g	RICHARDSON and PARKS (1939) (M.W. 178.22)
	25° (c_p) 9453.20 ,,	,,
	25° (c_p) 9448.1 ,,	PARKS, WEST, NAYLOR, FUJII and MC CLAINE (1946) (M.W. 178.220)

PHENANTHRENE $C_{14}H_{10}$

Estimation of anthracene in phenanthrene: Hirshberg and Bergmann (1939)

Constants

Saturated vapour pressure: Nelson and Senseman (1922)

t°	p mm	t°	p mm	t°	p mm
230	58.3	270	173.6	310	424.0
235	68.1	275	195.7	315	469.5
240	79.0	280	220.0	320	518.8
245	91.1	285	246.7	325	572.0
250	104.4	290	276.1	330	629.4
255	119.2	295	308.3	335	691.1
260	135.5	300	343.7	340	757.0
265	153.7	305	382.1		

Melting point

100°35 100°5	Narbutt (1905) Schiff (1884)	100°5	Bhatnagar and Singh (1928)

Heat of combustion	25° (c_v) 9396.0 cal 15°/g 25° (c_p) 9398.21 „	Richardson and Parks (1939) (M.W. 178.22) „

PYRENE $C_{13}H_{10}$

Constants: Jacobs and Parks (1934)

Melting point: 150°4

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −178.96	0.0841	−152.96	0.1079	−68.66	0.178	(maximum at −157°16)
−176.76	0.0855	−146.96	0.1067	−62.46	0.184	
−171.06	0.0900	−144.26	0.1097	−32.06	0.214	
−168.46	0.0924	−137.26	0.1160	−26.76	0.219	
−162.46	0.1014	−126.56	0.1254	+ 2.84	0.251	
−160.96	0.1060	−118.26	0.1322	8.04	0.257	
−155.86	0.1135	−105.36	0.1432	13.84	0.264	
−154.76	0.1113	− 83.16	0.1641	18.04	0.269	

Heat of combustion	25° (c_v) 9260.1 cal 15°/g 25° (c_p) 9261.12 „	Richardson and Parks (1939) (M.W. 202.24) „

H. POLYMETHYLENES

Cyclo-PROPANE C_3H_6

Constants: Ruehrwein and Powell (1946)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm
−90.029	26.26	−63.234	164.91	−43.283	473.90
−82.810	48.95	−58.114	220.85	−37.983	606.18
−77.465	66.73	−53.107	289.59	−34.809	698.39
−73.304	88.24	−48.029	375.88	−32.083	785.59
−68.117	122.02				

Boiling point: −32°86 *Melting point:* −127°62
—127°42 Knowlton and Rossini (1949)

Specific heat: (M.W 42.078)

t°	c_p	t°	c_p	t°	c_p
C. −258.71	0.0150	−205.98	0.2232	L. − 98.99	0.4271
−256.30	0.0207	−200.62	0.2365	− 90.90	0.4282
−253.36	0.03106	−195.74	0.2464	− 84.72	0.4301
−250.38	0.04416	−190.84	0.2576	− 77.61	0.4318
−247.07	0.05932	−185.67	0.2676	− 70.36	0.4351
−243.34	0.07712	−180.59	0.2780	− 63.16	0.4385
−239.20	0.09962	−175.61	0.2885	− 55.99	0.4423
−235.56	0.1183	−169.72	0.2963	− 48.89	0.4470
−232.04	0.1329	−164.13	0.3063	− 42.30	0.4527
−225.32	0.1603	−158.77	0.3137	− 36.12	0.4599
−221.10	0.1769	−153.16	0.3232	− 30.33	0.4608
−216.19	0.1944	−147.27	0.3348		
−211.16	0.2106	−141.34	0.3455		

Heat of vaporisation	(B.P.) 113.907 cal 15°/g	Knowlton and Rossini (1949)
Heat of melting	30.92 „	
Heat of combustion	(V.) 25°(c_p) 11166 „	

ETHYL-*cyclo*-BUTANE $C_4H_7-C_2H_5$

Boiling, melting and *critical solution points, density, surface tension* and *refractive index* Wibaut, Hoog, Langedyk, Overhoff and Smittenberg (1938)

Melting point Streiff, Zimmerman, Soule, Butt, Sedlak, Willingham and Rossini (1948)

Cyclo-PENTANE C_5H_{10}

Prepared by catalytic hydrogenation of *cyclo*pentene obtained by dehydration of synthetic *cyclo*pentanol.

Constants: B.E. (1937). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. atm.	d cr.	
238.60	44.550	0.270	Kay (1947)

Saturated vapour pressure

t°	p mm		t°	p mm	
15.707	217.19	Willingham, Taylor,	−47.25	6.23	Aston, Fink and
20.196	261.71	Pignocco and Rossini	−38.36	11.78	Schumann (1943)
25.598	324.94	„ (1945)	−31.64	18.35	„
31.172	402.45	„	−24.71	28.15	„
37.119	500.74	„	−18.61	40.20	„
43.574	627.97	„	−12.91	55.13	„
48.131	732.12	„	− 7.30	74.07	„
48.621	744.10	„	− 1.94	96.99	„
49.073	755.30	„	+ 4.46	131.78	„
49.587	768.07	„	9.32	164.63	„
50.031	779.47	„	14.24	204.39	„

Boiling point

49°2	Jacobs and Parks (1934)	49°26	Kay (1947)
49°2	Fenske, Braun, Wiegand, Quiggle, McCormick and Rank (1947)	49°262	Willingham, Taylor, etc. (1945)
		49°262	Forziati, Glasgow Jr., Willingham and Rossini (1946)
49°20	Wibaut, Hoog, Langedijk, Overhoff and Smittenberg (1939)	49°3	B.E. (1937) and Lecat (passim)
		49°35	Chavanne and Van Risseghem (1922)
		49°37	Thiry (1925)

$\frac{dt}{dp}$ *(10 mm)*

0°4004	Forziati, Glasgow Jr., etc.(1946)	0°402	Willingham, Taylor, etc. (1945)

Freezing point

−93°47	Aston, Fink and Schumann (1943)	−93°8	Glasgow Jr., Murphy, Willingham and Rossini (1946)
−93°77	Streiff, Murphy, Zimmerman, Sedlak, Soule, Willingham and Rossini (1947)	−93°917	Forziati, Glasgow Jr., etc. (1946)
		−94°1	Jacobs and Parks (1934)

Triple point: −93°45 Douslin and Huffman (1946)

Transition points

I −150°77	II −135°08	Douslin and Huffman (1946)
I −150°77	II −135°09	Aston, Fink and Schumann (1943)

Critical solution point

in $C_6H_5NH_2$	16°6	B.E. (1937)
	16°8	Thiry (1925)

Constants of state

Density

t°	d		t°	d	
0	0.76498	B.E. (1937)	20	0.74542	Wibaut, Hoog, etc. (1939)
15	0.75033	”	25	0.74040	”
30	0.73572	”	20	0.74538	Forziati, Glasgow Jr., etc.
0	0.7646	Chavanne and Van Risseghem (1922)	25	0.74045	” (1946)
			20	0.7453	Eykman (1906)
15	0.7503	”	20	0.7454	Kay (1947)
15	0.7505	Thiry (1925)			

Viscosity

t°	$\eta \cdot 10^5$	
15	460	B.E. (1937)
30	388	”

Surface tension

t°	γ		t°	γ	
15	23.16	B.E. (1937)	20	22.42	Wibaut, Hoog, etc. (1939)
20	22.57	”			
30	21.17	”			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.40668	1.40702	1.40910	1.40927	1.41318	1.41418	1.41723	—	B.E. (1937)
$\frac{dn}{dt}$	0.00052	53	—	54	55	55	55	—	„
20	—	1.40442	1.40649	—	—	1.41145	—	1.41546	Wibaut, Hoog, etc.
25	—	1.40157	1.40370	—	—	1.40855	—	1.4261	„ (1939)
$\frac{dn}{dt}$	—	0.00057	56	—	—	58	—	57	„
20	—	—	1.40646	—	—	—	—	—	Forziati, Glasgow Jr., etc. (1946)
25	—	—	1.40362	—	—	—	—	—	
$\frac{dn}{dt}$	—	—	0.00057	—	—	—	—	—	„
20	—	—	1.4065	—	—	—	—	—	Fenske, Braun, etc. (1947)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. I −180.16	0.193	C. III −123.16	0.300	−59.06	0.353	Jacobs and Parks (1934)
−174.16	0.201	−117.66	0.300	−36.06	0.370	
−166.86	0.210	−107.16	0.299	−30.86	0.372	„
−159.06	0.219	−101.86	0.299	−26.56	0.378	„
C. II −144.76	0.318	L. − 87.16	0.339	−21.56	0.382	„
−128.86	0.302	− 81.46	0.343	+ 3.24	0.407	„
−140.46	0.315	− 75.56	0.344	11.64	0.419	„
		− 70.06	0.347	15.64	0.424	„
		− 64.46	0.351	19.54	0.429	„
C. I −260.36	0.00779	C. III −131.82	0.3062			Aston, Fink and Schumann (1943) (M.W. 70.130)
−249.16	0.04225	−121.96	0.3049			
−238.56	0.07693	−111.41	0.3029			„
−227.06	0.1118	− 99.91	0.3007			„
−217.46	0.1355	L. − 89.08	0.3411			„
−209.86	0.14963	− 78.38	0.3455			„
−200.55	0.16609	− 61.02	0.3565			„
−191.16	0.17968	− 50.03	0.3650			„
−178.77	0.19852	− 38.29	0.3741			„
−167.12	0.21292	− 32.46	0.3791			„
C. II −149.45	0.3234	− 20.33	0.3885			„
−140.25	0.3219	− 5.15	0.4014			„
		+ 0.69	0.4074			„
		12.23	0.4241			„
		18.24	0.4305			„

Specific heat (continued)

t°	c_p	t°	c_p	
C. I −261.28	0.00623	−98.58	0.30401	DOUSLIN and HUFFMAN (1946)
−250.98	0.03418	L. −87.41	0.34255	„ (M.W. 70.130)
−241.93	0.06603	−77.96	0.34627	„
−231.10	0.09126	−67.62	0.35138	„
−218.22	0.1336	−55.56	0.35906	„
−211.65	0.14723	−45.68	0.36578	(Values at other temperatures: see authors)
−200.52	0.16632	−35.97	0.37254	
−187.69	0.18550	−26.44	0.38025	
−180.84	0.19471	−17.09	0.38851	„
−173.86	0.20341	− 7.93	0.39787	„
−159.34	0.22170	+ 1.05	0.40672	„
C. III −130.09	0.30811	9.87	0.41526	„
−122.85	0.30590	26.96	0.43416	„
−109.33	0.30411			„

Heat of vaporisation	25° 99.631 cal 15°/g	DOUSLIN and HUFFMAN (1946)

Heat of transition cal 15°/g		*Heat of melting* cal 15°/g	
—150°77 : 16.625	—135°09 : 1.1815	2.0555	ASTON, FINK and SCHUMANN (1943)
—150°77 : 16.645	—135°08 : 1.1738	2.0753	DOUSLIN and HUFFMAN (1946)

Heat of combustion	25° (c_p) 11215.4 cal 15°/g	JOHNSON, PROSEN and ROSSINI (1946) (M.W. 70.130)

METHYL-*cyclo*-PENTANE $C_5H_9—CH_3$

Prepared by hydrogenation of methyl-*cyclo*-pentene, B.E. (1937), or by isomerisation of *cyclo*-hexane with Al_2O_3. WIBAUT, HOOG, LANGEDYK, OVERHOFF and SMITTENBERG (1939).

Constants: B.E. (1937)

Critical constants

t° cr.	p cr. mm	d cr.	
259.61	37364	0.264	KAY (1947)

Saturated vapour pressure: Schmitt (1934)

t°	p mm	t°	p mm	t°	p mm
−16.30	16.80	21.25	116.3	50.23	369.9
0	41.8	31.06	177.4	60.45	525.6
10.85	72.1	38.45	238.3	65.90	626.9
19.90	109.3	41.30	265.9	72.87	779.6
21.20	116.1	46.13	318.8	76.65	873.5

Boiling point

71°8	Hicks-Bruun and Bruun (1931)	72°00	$\frac{dt}{dp}$ *(10 mm)* B.E. (1937) and Lecat (passim)
71°82	Kay (1947)	72°00	Chavanne and Simon (1919)
71°89	Schmitt (1934)		

Freezing point: −142°445 Glasgow Jr., Murphy, Willingham and Rossini (1946)

Triple point: −142°43 Douslin and Huffman (1946)

Critical solution point in $C_6H_5NH_2$

34°0	Wibaut, Hoog, etc. (1939)	34°7	Hicks-Bruun and Bruun (1931)
34°70	B.E. (unp.)	35°	Chavanne and Simon (1919)

Density

t°	d		t°	d	
0	0.76737	B.E. (1937)	20	0.7487	Hicks-Bruun and Bruun (1931)
15	0.75343	„			
30	0.73948	„	20	0.74869	Wibaut, Hoog, etc. (1939)
15	0.7533	Chavanne and Simon (1919)	25	0.74397	„

Viscosity

t°	$\eta \cdot 10^5$	
15	534	B.E. (1937)
30	448	„

Surface tension

t°	γ		t°	γ	
15	22.74	B.E. (1937)	20	22.17	Wibaut, Hoog, etc. (1939)
20	22.18	„			
30	21.06	„			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.40975	1.41023	—	1.41254	1.41649	1.41760	1.42064	—	B.E. (1937)
$\frac{dn}{dt}$	0.00050	50	—	51	51	52	51	—	„
20	—	1.40764	1.40983	—	—	1.41488	—	1.41896	Wibaut, etc. (1939)
25	—	1.40493	1.40713	—	—	1.41210	—	1.41621	„
$\frac{dn}{dt}$	—	0.00054	54	—	—	55	—	55	„
20	—	—	1.4098	—	—	—	—	—	Hicks-Bruun and Bruun (1931)

Specific heat: Douslin and Huffman (1946) (M.W. 84.156)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −260.36	0.00959	−180.71	0.18390	−103.11	0.36072	−19.12	0.40906
−252.24	0.03246	−172.22	0.19476	− 92.60	0.36445	−11.64	0.41525
−240.35	0.07191	−158.36	0.21377	− 82.22	0.36783	− 1.66	0.42415
−230.16	0.1002	−149.34	0.23143	− 71.99	0.37269	+ 8.11	0.43355
−223.98	0.1144	L. −137.06	0.35484	− 61.90	0.37843	18.13	0.44441
−210.07	0.13934	−128.27	0.35545	− 51.99	0.38458	28.36	0.45347
−203.94	0.15062	−117.41	0.35741	− 42.23	0.39068	34.36	0.46069
−189.63	0.17231	−111.52	0.35842	− 32.15	0.39844		

(Values at other temperatures: see authors)

Heat of melting	19.677 cal 15°/g	Douslin and Huffman (1946)
Heat of combustion	25° (c_p) 11173.4 „	Moore and Parks (1939)
	25° (c_p) 11183 „	Johnson, Prosen and Rossini (1946) (M.W. 84.156)

ETHYL-*cyclo*-PENTANE $C_5H_9.\ C_2H_5$

Constants

Critical constants

t° cr.	p cr. mm	d cr.	
296.30	33526	0.262	Kay (1947)

Boiling point: 103°45 Kay (1947)

Melting point

−138°435	**Streiff, Murphy, Zimmerman, Sedlak, Soule, Willingham** and **Rossini** (1947)
−138°460	**Glasgow** Jr., **Murphy, Willingham** and **Rossini** (1946)

Density: 20° 0.7632 **Grosse** and **Wackher** (1939)

Heat of combustion	25° (c_p) 11178.2 cal 15°/g	**Johnson, Prosen** and **Rossini** (1946) (M.W. 98.182)

n-PROPYL-*cyclo*-PENTANE $C_5H_9 \cdot n\text{-}C_3H_7$

Heat of combustion: **Johnson, Prosen** and **Rossini** (1946); *heat of vaporisation:* **Osborne** and **Ginnings** (1947)

n-BUTYL-*cyclo*-PENTANE $C_5H_9—n\text{-}C_4H_9$

Constants

Boiling point

156°7	**Crane, Boord** and **Henne** (1945)
156°8	**Thiry** (1925) and **Chavanne** and **Becker** (1927)

Freezing point: −108°2 **Timmermans; Chavanne** and **Becker** (1927)

Critical solution point

in $C_6H_5NH_2$	50°5	**Chavanne** and **Simon** (1919)
	51°1	**Thiry** (1925)

Density

t°	d		t°	d	
14.95	0.7887	**Chavanne** and **Becker**	15	0.7887	**Thiry** (1925)
20.2	0.7848	„ (1927)	20	0.7840	**Crane, Boord** and **Henne** (1945)

Refractive index

t°	Hα	D	Hβ	
20	—	1.4318	—	**Crane, Boord** and **Henne** (1945)
20.35	1.4292	1.4314	1.4366	**Chavanne** and **Becker** (1927)

DIMETHYL-*cyclo*-PENTANES $C_5H_8(CH_3)_2$

1,2-*cis* and -*trans*

Boiling, melting and *critical solution points, density, viscosity* and *refractive index* CHIURDOGLU (1938–1944)

1,1- and 1,2-*cis*

Melting point STREIFF, MURPHY, ZIMMERMAN, SEDLAK, SOULE, WILLINGHAM and ROSSINI (1947)

1,2-*trans*

Melting point GLASGOW Jr. (1940)

Cyclo-PENTENE C_5H_8

Constants: HUFFMAN, EATON and OLIVER (1948)

Triple point: –135°03 ,,

Freezing point: –135°082 STREIFF, MURPHY, SEDLAK, WILLINGHAM and ROSSINI (1946)

Density *Viscosity* *Surface tension*

t°	d	t°	$\eta \cdot 10^5$	t°	γ	
0	0.79229	15	365	15	23.28	LA BRUYÈRE (unp.)
15	0.77673	30	312	20	22.65	,,
30	0.76103			30	21.32	,,

Refractive index

t°	He r.	Hα	He y.	He g.	He v.	
15	1.42228	1.42266	1.42542	1.43072	1.43609	LA BRUYÈRE (unp.)
$\frac{dn}{dt}$	0.00055	55	55	56	58	,,

Specific heat: HUFFMAN, EATON and OLIVER (1948) (M.W. 68.114)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. I –261.07	0.0112	C. II –181.17	0.27185	–92.51	0.34826	–26.18	0.38278
–250.79	0.04735	–173.68	0.26936	–84.84	0.35007	–16.39	0.39102
–239.80	0.08789	–148.67	0.27696	–69.17	0.35584	– 6.78	0.39890
–231.11	0.1129	–141.39	0.28335	–60.66	0.35993	+ 2.66	0.40762
–221.05	0.1399	L. –109.55	0.34616	–46.34	0.36838	19.64	0.42430
–208.90	0.1714	–100.60	0.34683	–36.17	0.37515	26.68	0.43216
–202.10	0.1884						
–190.27	0.23975						
–187.16	0.28170						

(Values at other temperatures: see authors)

Heat of melting	11.80 cal 15°/g	HUFFMAN, EATON and OLIVER (1948)
Heat of transition	1.682 ,,	,,

1-METHYL-*cyclo*-PENTENE $C_5H_7—CH_3$

Prepared by dehydration of the methyl-*cyclo*-pentanol obtained from *cyclo*-pentanone.

Constants: B.E. (1937)

Boiling point: 75°85 $\frac{dt}{dp}$ *(10 mm)* 0°45 *Freezing point:* −123°35

Density		*Viscosity*		*Surface tension*	
t°	d	t°	$\eta \cdot 10^5$	t°	γ
0	0.79863	15	418	15	24.32
15	0.78452	30	359	20	23.82
30	0.77048			30	22.58

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.
15	1.43191	1.43237	1.43519	1.43536	1.44076	1.44239	1.44657
$\frac{dn}{dt}$	0.00051	51	—	52	53	54	54

Crane, Boord and Henne (1945) have studied a series of alkylpentenes.

1,5 and 1,2-DIMETHYL-*cyclo*-PENTENES $C_5H_6(CH_3)_2$

Prepared by dehydration of 1,2 dimethyl-*cyclo*-pentanol 1, by means of formic acid.

Constants: Chiurdoglu (1938)

		1,5–	1,2–
Boiling point		95°48—95°50	105°03
Freezing point		−118°1 Timmermans	−91°3 Timmermans
Density	0°	0.79855	0.81283
	15°	0.78512	0.79948
	20°	0.78055	0.79501
	30°	0.77155	0.78612
Viscosity $\eta \cdot 10^5$	15°	512.7	535.1
	30°	437.4	457.5
Refractive index	20°		
	Hα	1.43030	1.44139
	He y	1.43311	1.44436
	Hβ	1.43972	1.45142
	Hγ	1.44508	1.45717

Cyclo-HEXANE C_6H_{12}

The compounds of the *cyclo*-hexane series are prepared by hydrogenation of the corresponding benzene derivatives. Traces of benzene in the *cyclo*-hexane are eliminated by nitration followed by fractional fusion in order to get rid of traces of paraffins. The criteria of purity are the freezing point and the critical solution point in aniline.

Constants: B.E. (1926). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
280.2	—	0.2718	Simon (1938)
280.7	—	—	Fischer and Reichel (1943)
281.0	30835	—	Rotinjanz and Nagornow (1934)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
C. −4.51	20.55	4.03	34.05	10.03	48.45	Rotinjanz and Nagornow
−2.77	23.10	5.09	36.30	10.95	50.90	„ (1924–34)
−1.02	25.65	6.14	38.70	12.10	54.00	„
+1.13	28.80	L. 6.90	40.60	14.08	59.60	„
2.27	30.80	9.12	46.20	16.10	65.70	„
3.33	32.75					„
L. 6.32	40.41	13.62	57.73	20.96	81.83	Aston, Szasz and Fink
9.88	48.16	17.64	69.96	—	—	„ (1943)
23.72	90.96	36.81	161.23	80.74	757.50	Dejardin (1919)
25.55	98.84	38.50	172.96	80.82	759.30	„
29.14	116.05	42.25	201.33	80.89	760.76	„
32.68	135.43	80.35	750.00	81.01	763.50	„
34.06	143.80	80.66	755.59	81.06	764.50	„
19.915	77.28	44.108	217.22	79.502	732.13	Willingham, Taylor,
22.657	87.72	48.991	261.73	80.037	744.13	Pignocco and Rossini
26.347	103.67	54.884	324.96	80.534	755.32	„ (1945)
30.556	124.65	60.969	402.48	81.093	768.09	„
34.821	149.39	67.467	500.76	81.582	779.49	„
38.798	175.91	74.520	627.98			„
28.87	114.6	51.28	281.9	74.29	620.0	Schmitt (1934)
33.51	139.8	61.26	403.3	80.68	756.3	„
47.89	249.5	69.71	535.5			„
30	121.60	50	271.80	70	543.95	Scatchard, Wood and
40	184.61	60	389.29	80	743.27	Mochel (1939)

The measurements of Rotinjanz and Nagornow (1934) seem to be made carefully, but some of their values do not agree well with those of other authors.

Boiling point

80°70	Grimm (1929)	80°77	Thiry (1925)
80°738	Willingham, Taylor, etc. (1945)	80°80	B.E. (1926)
80°738	Forziati, Glasgow Jr., Willingham and Rossini (1946)	80°8	Richards and Barry (1915)
80°739	Scatchard, Wood and Mochel (1939)	80°8	Harrison and Berg (1946)
80°75	Rotinjanz and Nagornow (1934)	80°84	Schmitt (1934)
80°75	Lecat (passim)	80°84	Gjaldbaek and Hildebrand (1949)
		80°85	Dejardin (1919)

$\frac{dt}{dp}$ (10 mm)

0°434	Schmitt (1934)	0°444	Dejardin (1919)
0°437	Willingham, Taylor, etc. (1945)	0°45	B.E. (1926)
0°44	Grimm (1929)		

Freezing point

6°48	Eckfeldt and Lucasse (1943)	6°554	Glasgow Jr., Murphy, Willingham and Rossini (1946)
6°541	Forziati, Glasgow Jr., etc.(1946)	6°63	Rotinjanz and Nagornow (1924–34)
6°55	Thiry (1925)	6°68	Aston, Szasz and Fink (1943)
6°55	B.E. (unp.) corr. B.E. (1926)		

Triple point: 6°32/40.41 mm Aston, Szasz and Fink (1943)

Melting curve

t°	p kg/cm^2	t°	p kg/cm^2	
6.55	1	35.00	546	Deffet (1935)
10.00	66.5	40.00	647	,,
15.00	163	45.00	748	,,
20.00	260	50.00	847	,,
25.00	355	55.00	948	,,
30.00	449			,,

Transition point: –87°07 Aston, Szasz and Fink (1943)

Critical solution point

in $C_6H_5NH_2$	31°0	B.E. (1926)

Isotherms between 2⁰ and 300°, and from 4 to 100 atm: ROTINJANZ and NAGORNOW (1934)

Constants of state

Density

t°	d	
15	0.78310	B.E. (1926)
30	0.76928	„
60	0.74060	„
15.00	0.78315	MASSART (1936)
33.15	0.76616	„
43.35	0.75454	„
64.05	0.73661	„
79.20	0.72160	„
99.20	0.70080	„
13.5	0.7844	EYKMAN (1906)
13.5	0.7843	SABATIER and SENDERENS (1905)
15.0	0.7830	CHAVANNE and VAN RISSEGHEM (1922)
15	0.7830	THIRY (1925)
15.9	0.7824	EYKMAN (1909)
7.00	0.79063	ROTINJANZ and NAGORNOW
16.12	0.78221	„ (1934)
25.08	0.77384	„
40.21	0.75942	„
50.95	0.74416	„
78.05	0.72215	„
16.0	0.7823	HÜCKEL and HARDER
46.0	0.7540	„ (1947)
20	0.77853	FORZIATI, GLASGOW Jr.,
25	0.77389	„ etc. (1946)
20.0	0.7783	MICHIELEWICZ (1938)
25.0	0.77383	SCATCHARD, WOOD and MOCHEL (1939)
30.0	0.76914	„
30.0	0.7692	CHAVANNE and VAN RYSSEGHEM (1922)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 15^5$	
15	1056	B.E. (1926)	17	1030	DRAPIER (1911)
30	820	„	22	930	„
60	534	„	27	860	„
			32	790	„
			35	750	„

Surface tension

t°	γ		t°	γ	
15	25.64	HENNAUT-ROLAND and LEK	20	25.2	SMITH (1944)
20	24.99	„ (1931)			
30	23.82	„			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.42633	1.42670	1.42886	1.42914	1.43348	1.43430	1.43762	1.43870	B.E. (1926)
$\frac{dn}{dt}$	—	0.00052	52	52	—	54	—	— —	„
13.5	—	1.42777	—	—	—	1.43531	—	1.43972	SABATIER and SENDERENS (1905)
44.6	—	1.41056	—	—	—	1.41785	—	1.42214	
$\frac{dn}{dt}$	—	0.00055	—	—	—	56	—	56	„
20	—	1.42405	1.42630	—	—	1.43157	—	1.43592	WIBAUT, etc. (1939)
25	—	1.42134	1.42358	—	—	1.42878	—	1.43310	„
$\frac{dn}{dt}$	—	0.00054	54	—	—	55	—	56	„
20	—	—	1.42623	—	—	—	—	—	FORZIATI, etc. (1946)
25	—	—	1.42354	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00054	—	—	—	—	—	„
14.8	—	—	1.4292	—	—	—	—	—	HÜCKEL and HARDER (1947)
16.1	—	1.42626	—	—	—	1.43381	—	1.43820	EYKMAN (1906)
20	—	1.4242	—	—	—	—	—	—	MICHIELEWICZ (1938)
20	—	—	1.4263	—	—	—	—	—	HARRISON and BERG (1946)

Dielectric constant

t°	ε	t°	ε	t°	ε	
6.5	2.044	16.75	2.028	31.5	2.005	HADAMARD (1937)
7.15	2.0435	17.35	2.027	34.8	2.0015	„
7.6	2.0425	18.7	2.025	37.0	1.996	„
14.7	2.031	23.3	2.0175	38.15	1.9945	„
15.4	2.030	28.1	2.010			„
5	2.046	15	2.034	25	2.0199	LE FÈVRE (1938)
25	2.012					PIETTE (unp.)

Heat constants

Specific heat

t°	c_p	t°	c_p	
L. 22.50	0.506	41.40	0.518	Dejardin (1919)
29.70	0.512	50	0.524	„
C. I −260.43	0.0067	−111.86	0.2381	Aston, Szasz and Fink (1943
−251.80	0.0288	−101.84	0.2528	„ (M.W. 84.156)
−241.61	0.0575	− 92.33	0.2683	„
−229.97	0.0871	C. II − 81.86	0.3066	„ (Values at other
−219.98	0.105	− 71.70	0.3106	„ temperatures: see
−209.29	0.1211	− 61.18	0.3167	„ authors)
−200.26	0.1337	− 49.75	0.3250	„
−190.29	0.1462	− 38.95	0.3331	„
−179.71	0.1589	− 18.37	0.3510	„
−170.03	0.1691	− 7.76	0.3638	„
−160.96	0.1799	− 2.03	0.3674	„
−151.30	0.1906	L. + 11.73	0.4333	„
−137.00	0.2068	15.63	0.4382	„
−121.67	0.2243	19.30	0.4411	„

Heat of vaporisation	25°	93.821 cal 15°/g	Osborne and Ginnings (1947)
	„	94.82 „	Aston, Szasz and Fink (1943)
Heat of melting		7.466 „	„
Heat of transition		19.006 „	„
Heat of combustion	25°	(c_p) 11126.7 „	Moore and Parks (1939)
	25°	(c_p) 11132.6 „	Johnson, Prosen and Rossini (1946) (M.W. 84.156)

METHYL-*cyclo*-HEXANE $C_6H_{11}-CH_3$

In order to obtain pure methyl-*cyclo*-hexane, it is necessary to hydrogenate toluene which has been purified by sulphonation to get rid of the paraffins. Otherwise, it would be difficult to eliminate the latter from the methyl-*cyclo*-hexane.

Constants: B.E. (1926) — Polyphasic equilibria

Critical constants

t° cr.	p cr. atm.	d cr.	
299.13	34.322	—	Kay (1947)
299.5	—	0.2666	Simon (1938)

Boiling point

100°8	Hicks-Bruun and Bruun (1932)	100°83	Parks and Huffman (1930)
100°8	Bromiley and Quiggle (1933)	100°934	Forziati, Glasgow Jr., Willingham and Rossini (1946)
100°8	Harrison and Berg (1946)		
100°80	Richards and Hargreaves (1944)	100°94	Kay (1947)
		100°95	B.E. (unp.) corr. B.E. (1926)

$\frac{dt}{dp}$ (10 mm)

0°4671	Farziati, Glasgow Jr., etc. (1946)	0°49	Wibaut, Hoog, etc. (1939)
0°48	B.E. (unp.)		

Freezing point

−126°35	Wibaut, Hoog, etc. (1939)	−126°591	Forziati, Glasgow Jr., etc. (1946)
−126°4	Timmermans, Van der Horst and Kamerlingh Onnes (1922)	−126°596	Glasgow Jr., Murphy, Willingham and Rossini (1946)
−126°44	Hicks-Bruun and Bruun (1932)		

Triple point: −126°58 Douslin and Huffman (1946)

Critical solution point

in C_6H_5–NH_2	41°0	B.E. (1926)
	41°0	Hicks-Bruun and Bruun (1932)

Constants of state

Density

t°	d		t°	d	
−95.1	0.86893	Massart (1936)	0.0	0.7868	Chavanne and Van Rysseghem (1922)
−63.5	0.84144	,,			
−45.2	0.82561	,,	15.0	0.7737	,,
−22.9	0.80638	,,	30.0	0.7606	,,
0	0.78650	,,	0	0.78650	B.E. (1926)
15.00	0.77340	,,	15	0.77340	,,
29.95	0.76046	,,	30	0.76030	,,
45.20	0.74702	,,	16.3	0.7725	Eykman (1906)
60.70	0.73360	,,	16.9	0.7718	,,
79.75	0.71660	,,	20	0.76925	Hicks-Bruun and Bruun (1932)
99.50	0.69825	,,			
20	0.76944	Wibaut, Hoog, etc.	20	0.7693	Bromiley and Quiggle (1933)
25	0.76512	,, (1939)			
25	0.76496	Kretschmer and Wiebe (1949)	20	0.76936	Forziati, Glasgow Jr.,
			25	0.76501	,, etc. (1946)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	777	B.E. (1926)	15	780	CHAVANNE and VAN RYSSEGHEM (1922)
30	639	„	30	627	„

Surface tension

t°	γ		t°	γ	
15	24.43	HENNAUT-ROLAND and LEK	20	23.73	WIBAUT, HOOG, etc. (1939)
20	23.82	„ (1931)	20	23.74	DESREUX (1935)
30	22.72	„			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.42293	1.42305	1.42555	1.42570	1.42997	1.43072	1.43440	1.43510	B.E. (1926)
$\frac{dn}{dt}$	—	0.00047	47	47	—	48	—	49	„
20	—	1.42085	1.42310	—	—	1.42836	—	1.43285	WIBAUT, HOOG, etc.
25	—	1.41838	1.42063	—	—	1.42588	—	1.43022	„ (1939)
$\frac{dn}{dt}$	—	0.00049	49	—	—	50	—	53	„
20	—	—	1.42305	—	—	—	—	—	FORZIATI, GLASGOW Jr., etc. (1946)
25	—	—	1.42056	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00050	—	—	—	—	—	„
20	—	—	1.4230	—	—	—	—	—	HARRISON and BERG (1946)
20	—	—	1.4231	—	—	—	—	—	MARSCHNER and CROPPER (1946)
20	—	—	1.42312	—	—	—	—	—	B.E. (1949)
20	—	—	1.4232	—	—	—	—	—	BROMILEY and QUIGGLE (1933)
20	—	—	1.4234	—	—	—	—	—	HICKS-BRUUN and BRUUN (1932)
30	—	—	1.4182	—	—	—	—	—	RICHARDS and HARGRAVES (1944)
25	—	—	1.42059	—	—	—	—	—	KRETSCHMER and WIEBE (1949)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −173.96	0.162	L. −121.76	0.339	−43.76	0.389	**Parks** and **Huffman** (1930)
−167.66	0.170	−116.06	0.343	−28.26	0.400	,,
−159.56	0.178	−102.86	0.351	−13.16	0.412	,,
−160.96	0.179	− 90.56	0.359	+ 2.24	0.426	,,
−154.96	0.186	− 73.76	0.368	12.04	0.436	,,
−148.66	0.196	− 58.86	0.378	21.04	0.443	,,
−143.16	0.205					,,
C. −260.97	0.00794	−222.23	0.09359	L. −118.07	0.34314	**Douslin** and **Huffman** (1946) (M.W. 98.182)
−259.57	0.01039	−217.34	0.1014	−112.55	0.34599	
−258.88	0.01179	−215.09	0.10493	−107.84	0.34793	,,
−257.13	0.01576	−208.10	0.11549	−102.40	0.35160	,,
−256.47	0.01720	−201.29	0.12484	− 97.79	0.35422	,,
−253.24	0.02538	−195.25	0.13312	− 92.42	0.35681	,,
−253.14	0.02562	−188.75	0.14221	− 86.96	0.36001	,,
−249.20	0.03605	−181.80	0.15134	− 75.36	0.36677	,,
−248.32	0.03666	−174.51	0.16030	− 64.00	0.37360	,,
−245.16	0.03839	−166.32	0.17093	− 51.95	0.38215	,,
−244.43	0.04661	−157.10	0.18264	− 26.88	0.40200	,,
−240.83	0.05724	−147.47	0.19458	− 13.94	0.41305	,,
−240.77	0.05743	−137.53	0.20716	− 0.49	0.42523	,,
−235.56	0.06905	−135.77	0.20923	+ 12.60	0.43731	,,
−229.96	0.08004	−130.65	0.21774			,,
−223.74	0.09115					,,

Heat of vaporisation	25°	86.071 cal 15°/g	**Osborne** and **Ginnings** (1947)
Heat of melting		16.24 ,,	**Parks** and **Huffman** (1930)
		16.432 ,,	**Douslin** and **Huffman** (1946)
Heat of combustion	25° (c_p)	11113.8 ,,	**Johnson**, **Prosen** and **Rossini**(1946) (M.W. 98.182)

Iso-PROPYL-*cyclo*-HEXANE C_6H_{11}—$CH(CH_3)_2$

Boiling, freezing and ***critical solution points, density*** and ***refractive index:*** **Wibaut, Hoog, Langedijk, Overhoff** and **Smittenberg** (1939).

Freezing point: **Streiff, Murphy, Zimmerman, Sedlak, Soule, Willingham** and **Rossini** (1947).

ETHYL-*cyclo*-HEXANE $C_6H_{11}—C_2H_5$

Constants: HUFFMAN, TODD and OLIVER (1949)

Freezing point: −111°3194

Specific heat: (M.W. 112.208)

t°	c_p	t°	c_p	t°	c_p
C. −261.16	0.009946	−183.26	0.15378	L. −105.81	0.34868
−253.43	0.02881	−169.29	0.16919	−93.21	0.35578
−242.78	0.05597	−163.16	0.17637	−80.09	0.36293
−231.40	0.08043	−149.99	0.19188	−49.82	0.38368
−219.36	0.10214	−140.61	0.20265	8.03	0.41874
−212.26	0.11315	−132.57	0.21217	+ 6.24	0.43214
−198.32	0.13254	−125.01	0.22109	+ 26.03	0.45225

(other values, see authors)

Heat of vaporisation: (25°) 86.207 cal 15°/g OSBORNE and GINNINGS (1947)

Heat of melting: 17.750 ,, HUFFMAN, TODD and OLIVER (1949)

1,1 and 1,2 *trans*-DIMETHYL-*cyclo*-HEXANES $C_6H_{10}(CH_3)_2$

1,2-Dimethyl-*cyclo*-hexane is prepared by hydrogenation of dimethylhydroresorcin. The other dimethyl-*cyclo*-hexanes are obtained by hydrogenation of the corresponding xylenes.

Constants: MILLER (1935)

	1,1-dimethyl	1,2-dimethyl *trans*
Boiling point	119°8	123°70
Freezing point	−33°349	−88°172 HUFFMAN, TODD and OLIVER (1949)
	−33°54	−88°180 STREIFF, MURPHY, ZIMMERMAN, SEDLAK, SOULE, WILLINGHAM and ROSSINI (1947)
	−34°1	−89°4 MILLER (1935)
Transition point	−120°01	— HUFFMAN TODD and OLIVER (1949)
Critical solution point in C_6H_5–NH_2	45°4	48°3
Density 0°	0.79709	0.79188
20°	0.78073	0.77601
Viscosity $\eta \cdot 10^5$ 15°	1200	863
30°	998	697

Refractive index	18°8	26°4	$\frac{dn}{dt}$	18°8	26°4	$\frac{dn}{dt}$
He r.	1.42680	1.42359	0.00042	1.42493	1.42171	0.00042
He y.	1.42959	1.42635	43	1.42768	1.42443	43
He v.	1.43822	1.43489	44	1.43641	1.43331	41

Heat Constants: Huffman, Todd and Oliver (1949)

Specific heat: (M.W. 112.208)

1,1-dimethyl				1,2-dimethyl *trans*			
t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −259.06	0.01347	C. II −119.01	0.29664	C. −261.17	0.00737	−113.84	0.23398
−254.18	0.02635	− 83.12	0.32495	−253.67	0.02425	−111.70	0.23591
−243.19	0.05450	− 55.91	0.34837	−242.66	0.05200	L. − 89.48	0.35294
−230.28	0.07892	− 40.54	0.36301	−221.86	0.09227	− 71.31	0.36451
−222.50	0.09089	L. − 30.42	0.39297	−211.03	0.10898	− 48.11	0.37962
−211.40	0.10671	− 22.59	0.39946	−199.47	0.12564	− 24.83	0.39782
−197.47	0.12528	− 12.30	0.40913	−181.07	0.15115	− 4.40	0.41663
−185.67	0.14140	− 2.24	0.41870	−172.54	0.16181	+ 2.75	0.42351
−172.11	0.15910	+ 7.62	0.42803	−162.46	0.17460	11.67	0.43213
−161.00	0.17385	30.37	0.45152	−152.70	0.18690	20.45	0.44112
−151.71	0.18606			−142.24	0.19979	28.28	0.44964
−142.12	0.19857			−132.50	0.21217		
				−123.93	0.22202	(other values, see authors)	
				−117.42	0.29966		
Heat of transition:		12.747 cal 15°/g		—			
Heat of melting:		4.308 ,,		22.348 cal 15°/g			

1,2-DIMETHYL-*cyclo*-HEXANE *cis* $C_6H_{10}(CH_3)_2$ *cis*

Constants

Saturated vapour pressure: Willingham, Taylor, Pignocco and Rossini (1945)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
49.185	47.65	67.742	103.66	93.548	261.76	128.315	732.11
53.413	57.42	72.533	124.67	100.258	324.96	128.926	744.08
57.094	67.25	77.402	149.44	107.192	402.45	129.491	755.27
60.429	77.29	81.921	175.90	114.600	500.73	130.125	767.98
63.543	87.73	87.974	217.18	122.639	627.94	130.684	779.38

Boiling point

129°728	$\frac{dt}{dp}$ *(10 mm)* 0°4988 Forziati, Glasgow Jr., Willingham and Rossini (1946)
130°04	Miller (1935)

Freezing point

−49°882	Huffman, Todd and Oliver (1949)	−50°1	Miller (1935)
−50°00	Streiff, Murphy, Zimmerman, Sedlak, Soule, Willingham and Rossini (1947)	−50°211	Forziati, Glasgow Jr., Willingham and Rossini (1946)

Transition point: −100°66 Huffman, Todd and Oliver (1949)

Density

t°	d		t°	d	
0	0.81311	Miller (1935)	20	0.79627	Forziati, Glasgow Jr., etc.
20	0.79625	„	25	0.79222	„ (1946)

Viscosity

t°	$\eta \cdot 10^5$	
15	1188	Miller (1935)
30	925	„

Refractive index

t°	He r.	D	He y.	He g.	
18.8	1.43387	—	1.43663	1.44548	Miller (1935)
26.4	1.43061	—	1.43343	1.44211	„
$\frac{dn}{dt}$	0.00043	—	0.00042	0.00044	„
20	—	1.43596	—	—	Forziati, Glasgow Jr., etc. (1946)
25	—	1.43358	—	—	„
$\frac{dn}{dt}$	—	0.00048	—	—	„

Specific heat: Huffman, Todd and Oliver (1919) (M.W. 112.208)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. I −261.24	0.00778	−131.50	0.21109	C. II −260.97	0.01333	−172.86	0.29630
−252.56	0.02888	−121.23	0.22286	(unst).−252.55	0.03645	−164.26	0.29767
−242.83	0.05319	−119.44	0.22533	−241.07	0.06405	−148.06	0.30353
−232.56	0.07427	C. II − 97.68	0.33139	−222.56	0.09661	−139.77	0.30729
−220.98	0.09401	− 88.93	0.33481	−212.73	0.11188	−131.63	0.31094
−213.20	0.10600	− 70.48	0.34736	−203.53	0.12557	−122.40	0.31498
−201.64	0.12278	− 57.47	0.35675	−195.58	0.13796	−111.39	0.32085
−190.22	0.13900	L. − 44.86	0.38749	−182.77	0.16777	−106.60	0.32397
−182.44	0.14957	− 29.41	0.39896	−179.19	0.23983		
−170.18	0.16533	− 11.14	0.41453	−178.59	0.30197		
−159.20	0.17876	+ 2.50	0.42643			(other values,	
−141.88	0.20000	25.66	0.44857			see authors)	

Heat of vaporization	25° 84.589 cal 15°/g	Osborne and Ginnings (1947)
Heat of transition	16.695 „	Huffman, Todd and Oliver (1949)
Heat of melting	3.5042 „	„

1,3 and 1,4-DIMETHYL-*cyclo*-HEXANES $C_6H_{10}(CH_3)_2$

Constants: Miller (1935)

	1,3 *trans*	1,3 *cis*	1,4 *trans*	1,4 *cis*	
Boiling point	120°4	124°9	119°63	124°59	Miller (1935)
Freezing point	—	−75°560	−36°92	−87°425	Streiff, Murphy, Zimmerman, Sedlak, Soule, Willingham, and Rossini (1947)
	−90°097	−75°567	−36°943	−87°427	Huffman, Todd and Oliver (1949)
Critical solution point in C_6H_5–NH_2	51°7	46°3	52°7	46°9	Miller (1935)
Density 0°	0.78251	0.80022	0.77913	0.79925	,,
20°	0.76628	0.78348	0.76264	0.78271	,,
Viscosity $\eta \cdot 10^5$ 15°	665	888	749	933	,,
30°	556	722	614	749	,,

Refractive index

	1,3 *trans*		1,3 *cis*		1,4 *trans*		1,4 *cis*	
	18°8	26°4	18°8	26°4	18°8	26°4	18°8	26°4
He r.	1.42099	1.41772	1.42835	1.42495	1.41887	1.41556	1.42755	1.42425
He y.	1.42376	1.42047	1.43099	1.42765	1.42160	1.41827	1.43029	1.42700
He g.	1.43254	1.42919	1.43972	1.43645	1.43033	1.42697	1.43917	1.43568

Heat Constants: Huffman, Todd and Oliver (1949)

Specific heat: (M.W. 112.208)

1,3 *trans*		1,3 *cis*		1,4 *trans*		1,4 *cis*	
t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −260.75	0.009866	C. −259.98	0.01111	C. −259.20	0.01146	C. −260.87	0.00839
−253.70	0.03558	−254.23	0.02604	−252.77	0.02698	−253.99	0.02527
−242.72	0.03683	−243.30	0.05447	−242.86	0.05164	−241.05	0.05871
−232.43	0.07578	−233.30	0.07510	−230.77	0.07649	−230.57	0.07971
−213.88	0.10602	−221.23	0.095269	−212.12	0.10695	219.37	0.098620
−204.84	0.11962	−211.79	0.10966	−197.67	0.12831	−212.17	0.10955
−191.21	0.13904	−198.15	0.12921	−182.48	0.15037	−192.92	0.13653
−181.75	0.15190	−190.78	0.13969	−170.17	0.16632	−180.62	0.15341
−167.80	0.16994	−183.07	0.15019	−162.78	0.17614	−172.50	0.16345
−159.68	0.18015	−172.02	0.16454	−153.53	0.18839	−161.99	0.17674
−143.67	0.19985	−164.62	0.17508	−138.13	0.20775	—153.79	0.18679
−127.41	0.21972	−137.33	0.20777	−130.72	0.21708	−128.54	0.21677
−120.54	0.22817	−121.31	0.22646	−122.34	0.22758	—110.44	0.23635
−112.36	0.23838	−110.48	0.24176	− 97.39	0.26129	L. − 83.67	0.37130
−106.12	0.24533	−101.95	0.25216	− 72.39	0.30806	− 67.01	0.37949

Specific heat: (M.W. 112.208) (continued)

1,3 *trans*		1,3 *cis*		1,4 *trans*		1,4 *cis*	
t°	c_p	t°	c_p	t°	c_p	t°	c_p
L. −82.40	0.36771	L. − 68.97	0.36577	− 52.55	0.38371	− 58.50	0.38445
−70.30	0.37518	− 52.49	0.37677	L. − 28.39	0.40069	− 49.24	0.39019
−61.55	0.38085	− 22.35	0.40107	− 11.07	0.41442	− 38.88	0.39674
−42.51	0.39381	− 0.32	0.42076	+ 17.05	0.43999	− 24.84	0.40728
−22.52	0.40931	+ 17.77	0.43908	26.09	0.44908	+ 4.09	0.43204
− 3.15	0.42653	26.32	0.44700			30.06	0.45695
+ 7.06	0.43544						
25.98	0.45427						

(other values, see authors)

Heat of melting cal 15°/g

21.014	23.047	26.265	19.823

Cyclo-HEXENE C_6H_{10}

Prepared by dehydration of *cyclo*-hexanol

Constants

Boiling point

82°75	Lecat (passim)	83°1	Allsopp (1934)
82°8	Parks and Huffman (1930)	83°2	Harrison and Berg (1946)
82°84	Waterman and Van Westen (1929)	83°2	Hückel and Harder (1947)
82°9	Watson and Bircher (1949)		

Freezing point

−103°500	Streiff, Zimmerman, Soule, Butt, Sedlak, Willingham and Rossini (1948)	−103°7 −103°9 −104°1	Timmermans (passim) Seyer and King (1933) Parks and Huffman (1930)

Triple point: −103°49 Huffman, Eaton and Oliver (1948)

Transition point

−134°4	Parks and Huffman (1930)	−134°46	Huffman, Eaton and Oliver (1948)

Density

t°	d		t°	d	
0	0.8296	Seyer and King (1933)	−19.0	0.8481	Hückel and Harder
10	0.8202	„	+14.7	0.8158	„ (1947)
20	0.8109	„	46.0	0.7855	„
30	0.8017	„	77.6	0.7564	„ (1947)
40	0.7921	„	20	0.8110	Allsopp (1934)

Surface tension

t°	γ		t°	γ	
0	29.25	Seyer and King (1933)	−34.0	33.55	Hückel and Harder
10	27.89	„	−19.0	31.61	„ (1947)
20	26.54	„	0.0	29.13	„
30	25.22	„	15.2	27.23	„
40	23.98	„	35.8	24.76	„
			56.8	22.23	„
			76.0	20.09	„
			20	26.6	Smith (1944)

Refractive index

t°	Hα	D	Hβ	Hγ	
14.7	—	1.4495	—	—	Hückel and Harder (1947)
20	—	1.44644	—	—	Allsopp (1934)
20	—	1.4467	—	—	Harrison and Berg (1946)
20.05	1.44360	1.44637	1.45312	1.45874	Waterman and van Westen (1929)
25	—	1.4437	—	—	Watson and Bircher (1949)

Heat constants

Specific heat

t°	c_p	t°	c_p	
C. I −258.29	0.00961	L. −94.17	0.34225	Huffman, Eaton and Oliver (1948)
−251.98	0.0252	−79.22	0.35010	(M.W. 82.14)
−240.17	0.05977	−71.08	0.35479	„ (Values at other
−228.34	0.08866	−62.38	0.36018	„ temperatures: see
−217.24	0.1096	−52.86	0.36650	„ authors)
−210.19	0.1210	−43.04	0.37373	„
−201.79	0.13242	−32.51	0.38215	„
−189.04	0.14870	−21.73	0.39101	„
−180.86	0.15804	−19.28	0.39302	„
−169.52	0.16980	−11.19	0.39998	„
−161.75	0.17817	− 0.86	0.40934	„
−139.06	0.20489	+ 0.45	0.41047	„
C. II −125.01	0.28632	10.44	0.41979	„
−120.78	0.29020	19.43	0.42858	„
−111.63	0.30393	27.45	0.43640	„

Heat of transition	11.86 cal 15°/g	Parks and Huffman (1930)
	12.367 „	Huffman, Eaton and Oliver (1948)
Heat of melting	9.57 „	Parks and Huffman (1930)
	9.582 „	Huffman, Eaton and Oliver (1948)

Pure METHYL-*cyclo*-HEXENE has never been studied carefully.

1,4-DIMETHYL-*cyclo*-HEXENE $C_6H_8(CH_3)_2$

Constants: Chiurdoglu (1938)

Boiling point: 128°7

Freezing point: −59°4 Timmermans (passim)

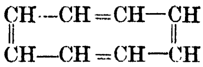
Density — *Viscosity* — *Refractive index*

t°	d	t°	$\eta \cdot 10^5$	t°	Hα	D	Hβ	Hγ
15	0.80472	15	695	20	1.44300	1.44586	1.45242	1.45805
20	0.80061	30	579					
30	0.79240							

Cyclo-HEXADIENE 1,3 C_6H_8

Boiling point, density and *refractive index* Allsopp (1934)

Cyclo-OCTATETRAENE



$$\begin{array}{llll} CH & -CH= & CH- & CH \\ \| & & & \| \\ CH & -CH= & CH- & CH \end{array}$$

Constants: Scott, Gross, Oliver and Huffman (1949)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm
0	1.51	35	13.72	60	46.79
15	4.29	40	17.91	65	58.20
20	5.84	45	23.06	70	71.89
25	7.84	50	29.45	75	88.13
30	10.43	55	37.26		

Melting point: −4°682 *Triple point:* −4°68

Specific heat: (M.W. 104.144)

t°	c_p	t°	c_p	t°	c_p	
C. −260.36	0.009813	−181.21	0.14197	−22.22	0.30602	(Values at other temperatures: see authors)
−253.88	0.02663	−165.98	0.15736	− 7.02	0.39937	
−242.61	0.05602	−147.50	0.17568	L. − 0.19	0.41101	
−234.64	0.07241	−117.66	0.20428	+14.41	0.41888	
−218.70	0.09700	− 77.55	0.24404	32.97	0.42959	
−212.28	0.10555	− 48.19	0.27534	52.20	0.44101	
−200.10	0.12039					

Heat of vaporisation	98.901 cal 15°/g
Heat of melting	25.873 „

TETRALIN or 1,2,3,4-TETRAHYDRONAPHTHALENE $C_{10}H_{12}$

Constants

Saturated vapour pressure

t°	p mm		t°	p mm	
93.8	20	Herz and Schuftan (1922)	150.0	162	Herz and Schuftan (1922)
103.0	30	,,	167.5	273	,,
140.0	118	,,	206.2	740	,,

Boiling point / *Melting point*

Boiling point		Melting point	
207°3	Herz and Schuftan (1922)	−35°0	Herz and Schuftan (1922)
207°57	Mair and Streiff (1941)	−35°80	Mair and Streiff (1941)

Density

t°	d		t°	d	
0.2	0.9842	Herz and Schuftan (1922)	24.7	0.9658	Herz and Schuftan (1922)
13.5	0.9743	,,	84.0	0.9210	,,
15.1	0.9731	,,	150.0	0.8718	,,
			25	0.9662	Mair and Streiff (1941)

Viscosity / *Surface tension*

t°	$\eta \cdot 10^5$	t°	γ	t°	γ	
25	2003	13.3	36.20	78.45	29.26	Herz and Schuftan (1922)
50	1302	36.7	33.62	179.6	18.83	,,
75	906.6	60.0	31.13			,,

Refractive index

t°	Hα	D	Hβ	
25	1.53466	1.53919	1.55065	Mair and Streiff (1941)

	5-METHYL-1,2,3,4-TETRAHYDRONAPHTHALENE $C_{10}H_{11}-CH_3$	6-METHYL-1,2,3,4-TETRAHYDRONAPHTHALENE $C_{10}H_{11}-CH_3$
Constants: Mair and Streiff (1941)		
Boiling point	234°35	229°03
Melting point	−22°90	−39°75
Density 25°	0.9682	0.9500
Refractive index	25°	25°
Hα	1.53738	1.52920
D	1.54190	1.53365
Hβ	1.55325	1.54498

DECALIN or DECAHYDRONAPHTHALENE *cis* and *trans* $C_{10}H_{18}$

Constants

Saturated vapour pressure: Seyer and Mann (1945)

Cis				*Trans*			
t°	p mm	t°	p mm	t°	p mm	t°	p mm
−30.0	0.44	83.5	38.18	−29.5	0.38	60.0	8.24
−24.1	0.60	95.5	55.01	−19.2	0.65	70.0	12.57
−11.1	1.07	112.4	95.11	−10.0	0.86	80.1	19.50
−0.7	1.73	119.4	121.10	0.0	1.09	92.4	32.81
0.0	1.82	136.7	206.85	12.0	1.48	105.1	54.50
13.0	2.87	152.3	320.65	20.0	1.82	109.8	63.15
30.9	6.03	168.0	489.49	38.0	3.44	112.4	68.66
38.9	8.23	187.1	776.05	43.4	4.00	124.6	105.21
51.5	12.02	208.8	1280.02	49.9	5.30	148.7	225.82
59.7	16.72	212.9	1396.4	50.4	5.41	172.7	434.28
65.3	20.00	223.4	1722.3	52.9	6.06	194.7	761.02
74.4	27.02	235.3	2145.3	56.9	7.31		

Melting point

Cis	*Trans*	
−43°26	−31°47	Seyer and Davenport (1941)

Density and *surface tension*

Cis			*Trans*			
t°	d	γ	t°	d	γ	
0	0.9120	34.50	0	0.8849	31.91	Seyer and Davenport
10	0.9044	33.36	10	0.8775	30.87	„ (1941)
20	0.8967	32.18	20	0.8700	29.89	„ (Values at other tem-
30	0.8892	31.01	30	0.8627	28.87	„ peratures, see authors)

Viscosity

Cis		*Trans*		
t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
00.00	5620	00.00	3233	Seyer and Leslie (1942)
10.00	4300	10.00	2588	„
20.00	3381	20.00	2128	„ (Values at other tempe-
30.00	2723	30.00	1774	„ ratures: see authors)

In a recent publication, Parks and Hatton (1949) give the heat constants of the same compounds with samples, melting respectively at −43°06 and −30°76, but they consider these both samples as not very pure since they contain, the first 0.4 mole % impurity and the second, 1.1 mole % impurity.

α-PINENE and β-PINENE $C_{10}H_{16}$

Boiling point, density, refractive index and *rotatory power* Fuguitt, Stallcup and Hawkins (1942)

Natural and magnetic rotatory power Rabinovitch (1940)

2. HALOGENATED DERIVATIVES

The monohalogenated derivatives of the paraffins are generally obtained by the action of the hydracid on the corresponding alcohol in presence of sulphuric acid as dehydrating agent; the crude products are therefore contaminated by the alcohol which has been used in the preparation and with which moreover many of them give azeotropes.

It is easy to eliminate these alcohols by washing followed by distillation on a water bath over P_2O_5, but on progressing in the series, particularly with secondary and tertiary compounds, the low stability of the halogenated derivative, especially if it contains bromine or iodine, may lead to partial decomposition of the product with formation of hydracid and an ethylenic hydrocarbon.

For iodides, the following method of purification can be recommended: the alcohol is caused to react with iodine in presence of red phosphorus; the iodine, dried over sodium sulphate, is decolorised by shaking with mercury and distilled at ordinary pressure until the density is constant for several successive fractions, even after treatment with sodium carbonate. The iodides must be kept in the dark.

A. HALOGENATED DERIVATIVES OF METHANE

These compounds have been studied a great deal. Most of them are provided by industry.

METHYL FLUORIDE CH_3F

Preparation: This gas is obtained by action of a metallic fluoride on potassium methylsulphate or methyl iodide. Moles and Batuecas (1919–20).

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−103.30	150.9	−82.36	594.1	−78.30	746.2	Moles and Batuecas (1929)
− 87.80	429.8	−82.43	592.9	−78.20	757.9	
− 87.50	439.2	−81.57	628.3	−77.70	774.8	,,
− 87.08	465.2	−81.14	651.7	−77.50	790.2	,,
− 85.71	489.1	−80.47	663.9	−75.73	871.7	,,
− 85.59	493.9	−78.60	731.4			,,

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
−108.887	98.50	−71.699	1083.30	−48.742	3074.66	MICHELS and
−105.887	124.79	−69.190	1229.68	−47.387	3249.0	WASSENAAR
−101.848	169.56	−66.908	1375.45	−40.372	4262.84	„ (1948)
− 98.222	220.17	−64.820	1519.92	−31.097	5953.84	„
− 93.383	306.20	−62.301	1710.30	−25.756	7127.28	„
− 87.838	437.23	−58.988	1987.02	−21.015	8309.08	„
− 85.309	509.96	−56.384	2229.69	−11.374	11155.28	„
− 82.743	593.03	−54.920	2375.91	− 4.350	13642.76	„
− 80.359	679.97	−53.597	2514.31	+ 1.235	15912.12	„
− 77.321	804.61	−51.926	2697.01	6.889	18477.88	„
− 74.120	964.54	−50.334	2881.92	15.208	22841.80	„

Boiling point

−78°14	(interp.)	MOLES and BATUECAS (1920)
−78°414	„	MICHELS and WASSENAAR (1948)

Weight of the normal litre: 1.54507 g MOLES and BATUECAS (1920) (corr. val. 1919)

Molecular weight of the gas: 34.0318 CAWOOD and PATTERSON (1936)

Deviation from Avogadro's law: $A_0^1 = 1.01771$ MOLES and BATUECAS (1920)

METHYL CHLORIDE CH_3Cl

Survey of the thermal properties of methyl chloride: G. HOLST (1913) and TANNER, BENNING and MATHEWSON (1939). R. PIECK and CH. COURTOY (1947) are examining the methods of preparation of this compound; they suggest the action of PCl_5 on methanol or, even better, direct chlorination of methane to obtain a product quite free from dimethylether.

Constants

Critical constants

t° cr.	p cr. atm.	d cr.	
143.12	65.93	0.353	BRINKMAN (1904)
143.2	65.85	—	BAUME (1908)

Saturated vapour pressure

t°	p mm	t°	p mm	
−75	45	−10	1349	Ganeff and Jungers (1948)
−60	121	−5	1622	„
−50	216	0	1945	„
−40	365	+5	2315	„
−30	588			„
−20	907			„
−25	729	—	—	Kamerlingh Onnes and Zakrzewsky (1904)

t°	p atm.	p mm	
−47.20	0.3173	or 241.15	Holst (1913–1914)
−39.28	0.4869	370.04	„
−30.26	0.7467	567.49	„
−14.39	1.4941	1135.52	„
− 4.65	2.1536	1636.74	„
+10.58	3.658		„
16.20	4.369		„
20.58	4.992		„
26.96	5.974		„
32.77	7.072		„
33.18	7.118		„
39.70	8.625		„
100.02	31.44		Brinkman (1904)
114.96	41.17		„
130.82	53.15		„

Boiling point: −24°09 Gibbs (1905)

Freezing point: −97°720 Glasgow Jr., Krouskop, Beadle, Axilbrod and Rossini (1948)

Weight of the normal litre: 2.3075 g Batuecas (1926)

Deviation from Avogadro's law: A_0^1 1.0244 Batuecas (1926)

Compressibility of the gas: at 16° Leduc (1898–1909); at 20°6 Holst (1913–1914)

METHYL BROMIDE CH_3Br

Constants: Egan and Kemp (1938)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm
−69.974	12.98	−30.062	167.39	−8.140	472.50
−61.915	23.83	−22.527	244.67	−2.279	601.78
−52.913	44.18	−15.152	346.44	+1.072	690.97
−44.326	75.34	−15.144	346.64	+4.522	790.56
−36.676	117.09				

Boiling point	*Melting point*	*Transition point*
+ 3.457	−93.72	−99°41

Weight of the litre: at 25° and 1 atm. 3.9739 g

Specific heat

t°	c_p	t°	c_p	t°	c_p
C. I −258.54	0.01529	−166.44	0.1287	L. −88.70	0.1963
−255.67	0.02155	−160.18	0.1311	−83.08	0.1962
−251.77	0.03028	−153.99	0.1332	−76.62	0.1951
−247.71	0.03907	−147.70	0.1348	−70.24	0.1948
−244.00	0.04629	−141.24	0.1371	−57.11	0.1947
−239.63	0.05495	−135.10	0.1392	−38.42	0.1945
−234.89	0.06500	−129.15	0.1403	−26.09	0.1952
−228.98	0.07423	−122.93	0.1418	−20.30	0.1962
−223.37	0.08217	−116.71	0.1432	−14.69	0.1964
−217.97	0.09062	−110.76	0.1442	− 8.91	0.1969
−212.03	0.09774	−107.89	0.1451	− 2.91	0.1977
−206.29	0.1028	−104.95	0.1470	+ 2.43	0.1978
−200.95	0.1072	C. II − 97.95	0.1623		
−193.62	0.1119	− 96.75	0.1639		
−190.05	0.1158	− 96.68	0.1650		
−184.56	0.1197	− 96.28	0.1652		
−178.63	0.1227	− 95.40	0.1729		
−172.61	0.1259				

Heat of vaporisation	*Heat of melting*	*Heat of transition*
60.2275 cal 15°/g	15.0542 cal 15°/g	1.1946 cal 15°/g

METHYL IODIDE CH_3I

Gives an azeotropic mixture with 8 % of methyl alcohol, boiling at 39°6 (Holley, 1902).

Constants: B.E. (1934)

Saturated vapour pressure

t°	p mm		t°	p mm	
0.1	142	Thompson and Linnett (1936)	11.7	235	Thompson and Linnett (1936)
4.3	171	„	34.4	569	„

Boiling point: 42°50 $\frac{dt}{dp}$ *(10 mm):* 0°36 B.E. (1934) and Lecat (passim)

Freezing point: −66°45

Density

t°	d		t°	d	
0	2.33504	B.E. (1934)	30	2.25102	B.E. (1934)
15	2.29300	„			

Viscosity

t°	$\eta \cdot 10^5$	
15	518	B.E. (1934)
30	460	„
0	594	Linebarger (1896)
0	593	Sachanov and Rjakowsky (1914)

Surface tension

t°	γ	
15	30.92	B.E. (1934)
20	30.14	„
30	28.61	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.52836	1.52900	1.53444	1.54497	1.54733	1.55537
$\frac{dn}{dt}$	0.00065	65	65	66	66	67

METHYLENE DICHLORIDE CH_2Cl_2

Constants: B.E. (1932)

Saturated vapour pressure

t°	p mm	t°	p mm	
−40	15	10	229	Ganeff and Jungers (1948)
−30	28	15	284	,,
−20	51	20	350	,,
−10	88	25	429	,,
− 5	114	30	523	,,
0	145	35	630	,,
+5	183	40	755	,,

Boiling point

39°95	$\frac{dt}{d_p}$ *(10 mm)* 0°43 B.E. (1932)	
40°0	,, 0°42 Lecat (passim)	
40°21	Ganeff and Jungers (1948)	

Freezing point

−96°5	Hrynakowski and Szmyt (1938)
−96°8	B.E. (1932)

Density

t°	d		t°	d	
0	1.36174	B.E. (1932)	30	1.30777	B.E. (1932)
15	1.33479	,,	20	1.3255	Eftring (1938)

Viscosity

t°	$\eta \cdot 10^5$	
15	449	B.E. (1932)
30	393	,,

Surface tension

t°	γ	
15	28.83	B.E. (1932)
20	28.12	,,
30	26.54	,,

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	
15	1.42433	1.42466	1.42721	1.43186	1.43297	1.43694	B.E. (1932)
$\frac{dn}{dt}$	0.00054	54	55	55	55	57	„
20	—	—	1.4244	—	—	—	EFTRING (1938)

Specific heat

t°	c_p	t°	c_p	t°	c_p	
L. −58.0	0.2767	−29.0	0.2741	− 0.5	0.2788	PERLICK (1937)
−53.8	0.2762	−23.7	0.2741	+ 7.9	0.2812	„
−46.0	0.2750	−19.0	0.2744	13.7	0.2832	„
				19.3	0.2838	„

Heat of combustion: 20° (c_v) 1690.8 cal 15°/g EFTRING (1938)

METHYLENE DIBROMIDE CH_2Br_2

Constants: B.E. (1932)

Boiling point *Freezing point*

96°95	$\frac{dt}{dp}$ *(10 mm)* 0°42	−52°7
97°0	„ 0°42 LECAT (passim)	

Density

t°	d	
0	2.54852	B.E. (1932)
15	2.50986	„
30	2.47133	

Viscosity

t°	$\eta \cdot 10^4$	
15	108.9	B.E. (1932)
30	91.6	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.53950	1.54012	1.54463	1.55299	1.55502	1.56163
$\frac{dn}{dt}$	0.00054	54	54	55	55	57

METHYLENE DIIODIDE CH_2I_2

This compound decomposes at the boiling point.

Constants: B.E. (1932)

Freezing point: 6°10 (stable form)
5°60 (metastable form)

Melting curve: Deffet (1935) *Transition curve:* Deffet (1935)

Form I		*Form II*		*Form III*		*II → III*			
t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²
6.10	1	5.60	1	14.00	454	−6.5	1	8.35	330
7.90	108	9.00	190	15.00	506	−0.2	143	10.80	382
8.30	130	10.80	282	16.90	596	+2.30	200	12.90	430
9.60	202	11.90	340	18.40	690	6.80	300		
10.00	220	13.00	412	20.30	786				
12.30	348	14.00	454	22.50	900				
13.20	390								
14.80	478								
17.50	620								
18.50	670								
20.00	752								
24.00	954								
25.00	1020								

Density *Viscosity*

t°	d	
15	3.3345	B.E. (1932)
20	3.3212	,,
30	3.2944	,,

t°	$\eta \cdot 10^4$	
15	304.3	B.E. (1932)
30	239.2	,,

Refractive index

t°	Hα	D	He y.	Hβ
15	1.73403	1.74428	1.74461	1.77161
$\frac{dn}{dt}$	0.00061	—	64	67

TRICHLOROMETHANE or CHLOROFORM $CHCl_3$

Purification: B.E. (1926)

Very pure chloroform is unstable in the presence of air; it tends to oxidise with formation of phosgene and hydrochloric acid (Clover, 1923; Allport, 1931). Determination of the impurities and study of the stability of chloroform (Gillo, 1938). Ionisable chlorine is determined in the form of silver chloride by nephelometry or by titration.

Gillo (1938) showed that it is hardly possible to reduce the concentration of $COCl_2$ below $3 \cdot 10^{-4}$ %, which appears to indicate that the chloroform decomposes even during its purification. It is easy to obtain the fifth degree of purity ($\triangle t = 0°000$) as shown by the ebulliometer of Swietoslawski.

The pharmaceutical product contains about 1 % of ethyl alcohol which acts as stabiliser; it is hardly possible to remove this impurity by distillation since there is an azeotropic mixture which contains 7 % of alcohol and boils only 1°5 lower than pure chloroform (Wade and Finnemore, 1904). It is therefore necessary to eliminate the alcohol by distillation with phosphoric anhydride; the danger of this operation, especially if carried out in presence of air, lies in the liberation of traces of hydrochloric acid, which can only be eliminated by treatment with sodium carbonate (Timmermans, 1910). These conditions make the preparation and especially the conservation of pure chloroform a somewhat difficult matter; it keeps best in sealed tubes, protected from the air and in the dark.

Alcohol lowers the density and hydrochloric acid raises it; the density is an excellent criterion of purity.

Constants: B.E. (1926). — **Polyphasic equilibria**

Critical constants. Chloroform decomposes at the critical temperature.

Saturated vapour pressure

t°	p mm	t°	p mm	
−62.1	1.0	−42.0	4.5	Stock and Stieber (1923)
−57.1	1.5	−11.8	39	„
−51.5	2.0	0	62	„
−46.6	3.0			„
0	61.0	20	158.4	Rex (1906)
10	100.0	30	240.0	„
0	60.9	20	157.6	Winkler (1906)
10	99.1	30	240.7	„

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	
0	60.17	15	125.75	**Radulescu** and **Alexa** (1938)
5	77.47	20	157.64	„
10	99.46	22	172.13	„
18	146	51	541	**Beckmann** and **Liesche** (1914)
30	239	60	731	„
35	295.11	50	519.18	**Scatchard** and **Raymond** (1938)
40	360.20	55	617.84	„
45	433.54	60	730.13	„
39.620	355.1	72.118	1074.6	**Zmaczynski** (1930)
44.950	433.6	77.669	1268.1	„
50.361	525.76	83.246	1489.2	„
55.716	633.90	88.857	1741.0	„
61.152	760.00	94.504	2026.3	„
66.622	906.1	100.186	2374.4	„
33.25	276			**Kohnstamm** and **Van Dalfsen** (1901–1902)

Boiling point

61°152	**Zmaczynski** (1930)	61°2	**Eftring** (1938)
61°16	**Wade** and **Finnemore** (1904)	61°2	**Lecat** (passim)
61°17	**Stull** (1937)	61°2	**Beckmann** and **Liesche** (1914)
61°20	B.E. (1926)	61°27	**Van der Werf**, **Davidson** and **Michaelis** (1948)
61°2	**Young** (1910)		

$\frac{dt}{dp}$ *(10 mm)*

0°37	**Lecat** (passim)	0°403	**Zmaczynski** (1930)
0°38	B.E. (1926)	0°41	**Beckmann** and **Liesche** (1914)
0°39	**Regnault** (1862)		

Melting point

−63°49	**Stull** (1937)	−63°5	**Timmermans**, **Van der Horst** and **Kamerlingh Onnes** (1922) and B.E. (1926)

Constants of state

Density

t°	d	t°	d	
−63.3	1.64312	−22.95	1.56888	Timmermans (1912)
−53.6	1.62580	−13.1	1.55071	„
−45.0	1.60987	− 6.2	1.53811	„
−37.2	1.59511	0.0	1.52637	„
−35.3	1.59217	15.0	1.49849	„
−30.6	1.58325			„

t°	d		t°	d	
0	1.52638	B.E. (1926)	0	1.52649	Tyrer (1914)
15	1.49845	„	20	1.4890	Gorke, Köppe and Staiger (1908)
30	1.47060	„			
0	1.52649	Young (1910)	20	1.48913	Zmaczynski (1930)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	596	B.E. (1926)	9.50	637	Kolossowski (1925)
30	514	„	15.4	599	„
20	568	Gartenmeister (1890)	16.30	592	„
			22.8	555	„

Surface tension

t°	γ		t°	γ	
15	28.6	Hennaut-Roland and Lek (1931) (corr. Lek „ (1930))	25	26.5	Hannan and Marklam (1949)
20	27.28				
30	25.89		25	26.67	Cupples (1946)

Refractive index

t°	Hα	D	He y.	Hβ	Hγ	
15	1.44586	1.44858	1.44865	1.45490	1.46015	B.E. (1926)
$\frac{dn}{dt}$	0.00058	59	59	61	62	„
20	1.4431	1.4455	—	1.4517	1.4571	Gorke, Köppe and Staiger (1908)

Dielectric constant

t°	ε		t°	ε	
0	5.189	Ball (1930)	−20	5.512	Le Fevre (1938)
11.2	4.971	„	−10	5.400	„
18.0	4.848	„	+10	4.999	„
25.0	4.724	„	20	4.813	„
30.0	4.636	„			
40.0	4.473	„			
50.0	4.310	„			

Heat constants

Specific heat

t°	c_p		t°	c_p	
22.40	0.230	Tréhin (1921)	39.22	0.232	Tréhin (1921)
30.52	0.231	„	43.57	0.237	„
34.48	0.233	„	48.64	0.237	„

Heat of vaporisation	20° 66.7 cal 15°/g	Swietoslawski and Bartoszewicz (1931)
Heat of combustion	20° (c_v) 935 „	Eftring (1938)

TRIBROMOMETHANE or BROMOFORM $CHBr_3$

Constants: B.E. (1926)

Boiling point

149°18	Van der Werf, Davidson and Michaelis (1948)	149°55	$\frac{dt}{dp}$ *(10 mm)* 0°49 B.E. (1926)
149°5	$\frac{dt}{dp}$ *(10 mm)* 0°49 Lecat (passim)		„ 0°50 Paul and Schantz (1919)

Freezing point

8°05	B.E. (1926)
8°3	Van der Werf, Davidson and Michaelis (1948)

Density

t°	d	
15	2.90350	B.E. (1926)
30	2.86460	„
20	2.8905	Desreux (1935)

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	2152	B.E. (1926)	20	31.68	Desreux (1935)
30	1741	,,			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	Hγ
15	1.59472	1.59530	1.60053	1.60088	1.61133	1.61345	1.62437
$\frac{dn}{dt}$	0.00056	56	57	57	57	57	57

TRIIODOMETHANE or IODOFORM CHI_3

Van de Vloed (1939) studied this substance very carefully with respect to purification and freezing point.

MONOFLUORODICHLOROMETHANE $CHFCl_2$

Constants: Benning and Mac Harness (1939)

Critical constants

t° cr.	p cr. atm.	d cr.	
178.5	51.0	0.522	

Isotherms: Benning and Mac Harness (1940)

Boiling point: 8°9

Freezing point: −135°

Viscosity: 0° $412 \cdot 10^{-5}$ Lacher, Walden and Park (1949)

DIFLUOROMONOCHLOROMETHANE CHF_2Cl

Constants: *Critical constants*

t° cr.	p cr. atm.	
96°4	48.48	Booth and Swinehart (1935)
96°0	48.7	Benning and Mac Harness (1939)

Saturated vapour pressure, rectilinear diameter and isotherms: see Benning and Mac Harness (1939-40)

Boiling point: −40°8 Benning and Mac Harness (1939)

Freezing point: −160° ,,

Specific heat: see Benning and Mac Harness (1939)

DICHLOROMONOBROMOMETHANE $CHCl_2Br$

The same care must be taken during purification as in the case of chloroform, as the substance is very unstable.

Constants: B.E. (1926)

Boiling point: 90°10 $\frac{dt}{dp}$ *(10 mm)* 0°53

Freezing point: –56°9

Density

t°	d	
0	2.0385	B.E. (1926)
15	2.0055	„
30	1.9724	„

Viscosity

t°	$\eta \cdot 10^5$	
15	1844	B.E. (1926)
30	1456	„

Refractive index

t°	Hα	D	He y.	Hβ	Hγ
15	1.49773	1.50120	1.50136	1.50952	1.51633
$\frac{dn}{dt}$	0.00054	54	55	55	55

TETRAFLUOROMETHANE or CARBON TETRAFLUORIDE CF_4

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
S. –193.1	0.1	–168.29	12.2	–133.19	517.3	Menzel and Mohry
–186.8	0.45	–167.76	13.3	–129.69	672.4	„ (1933)
L. –180.65	1.5	–165.73	17.6	–128.29	744.9	„
–178.79	2.2	–163.90	22.5	–127.98	761.4	„
–176.72	3.1	–163.59	23.5	–127.77	772.4	„
–173.68	5.2	–163.29	24.5	–127.76	773.1	„
–170.90	8.2	–138.69	331.7	–127.29	798.9	„

Molecular weight of the gas: 87.989 Cawood and Patterson (1936)
Boiling point: –128°0 Menzel and Mohry (1933)
Triple point: –183°6 „

TETRACHLOROMETHANE or CARBON TETRACHLORIDE CCl_4

Purification: by fractional distillation. Some authors subject the product to chemical treatment in order to eliminate sulphur compounds, but this is unnecessary when starting from a good commercial sample. The criteria of purity used at the B.E. are the constancy of boiling point and density. YOUNG used also as a criterion of purity the constancy of the saturated vapour tension during the whole isothermal liquefaction.

Constants: B.E. (1926). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
283.15	34181	0.5576	YOUNG (1900–1910)
283.2	—	—	FISCHER and REICHEL (1943)

Densities of the liquid and the saturated vapour: YOUNG (1910)

t°	d. liq.	d. vap.	t°	d. liq.	d. vap.
50	1.53611	—	180	1.2470	0.05249
60	1.5163	—	190	1.2192	0.06250
70	1.4963	0.004570	200	1.1888	0.07418
80	1.4765	0.006083	210	1.1566	0.08787
90	1.4554	0.007955	220	1.1227	0.1040
100	1.4343	0.01027	230	1.0857	0.1232
110	1.4124	0.01307	240	1.0444	0.1464
120	1.3902	0.01639	250	0.9980	0.1754
130	1.3680	0.02037	260	0.9409	0.2146
140	1.3450	0.03040	270	0.8666	0.2710
160	1.2982	0.03650	280	0.7634	0.3597
170	1.2734	0.04367			

Rectilinear diameter: $0.8165—9564 \cdot 10^{-7}\, t° + 1480 \cdot 10^{-10}\, t°^2$ YOUNG (1900)

Saturated vapour pressure

t°	p mm	t°	p mm	
−50.1	0.925	−59.6	0.384	MÜNDEL (1913)
−54.8	0.595	−65.3	0.224	„
−56.8	0.504	−69.7	0.145	„
−58.8	0.410			„

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	
−21.4	9.10	−10.7	18.10	**Drucker, Jimeno** and **Kangro** (1915)
−17.4	11.87	− 2.8	28.62	
−20	9.92	150	4555	**Young** (1910)
−10	18.81	160	5539	"
0	33.08	170	6641	"
10	55.65	180	7899	"
20	89.55	190	9311	"
30	139.6	200	10936	"
40	210.9	210	12759	"
50	309.0	220	14795	"
60	439.0	230	17056	"
70	613.8	240	19633	"
90	1112	250	22414	"
100	1457	260	25528	"
110	1880	270	28991	"
120	2391	280	32825	"
130	3002	283.05	34133	"
140	3725			"
0	33.4	20	91.3	**Rex** (1906)
10	56.3	30	141.1	"
0	33.4	28.53	132.9	**Van Dalfsen** (1906)
25	114.9			**Wood** (1937)
33.1	160.5	53.95	360	**Schreinemakers** (1904)
38.5	200	58.3	420	"
44.3	250	62.2	480	"
49.0	300	66.3	550	"
34.8	175			**Kohnstamm** and **van Dalfsen** (1901–1902)
50	308			**Sackur** (1910)

Boiling point: All modern authors agree on this boiling point.

76°687	**Zmaczynski** (1936)	76°75	**Titani** (1927)
76°7	**Lacoss** and **Menzies** (1937)	76°75	$\frac{dt}{dp}$ *(10 mm)* 0°44 B.E. (1926) and **Lecat** (passim)
76°7	**Rex** (1906)		
76°7	**Eftring** (1938)		
76°72	**Hoeppener** and **Antropoff** (1930–1931)	76°75	**Young** (1910)
		76°75	**Stull** (1937)
76°74	**Thorpe** (1880)	76°76	**Desreux** (1935)

Freezing point: All modern authors agree on this value.

−22°85	Skau (1933)	−22°96	Staveley and Gupta (1949)
−22°95	B.E. (1926) and Deffet (1935)		

Transition point: −47°41 Staveley and Gupta (1949)

Melting curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²
−22.95	1	− 5.0	512	7.50	866
−15.2	218	0.00	656	10.00	938
−10.0	367	5.00	796		

Constants of state

Density

t°	d		t°	d	
0	1.63255	B.E. (1926)	17.15	1.59982	Egerton and Lee (1923)
15	1.60370	„	17.75	1.59834	„
30	1.57480	„	18.26	1.59753	„
			0	1.6327	Desreux (1935)
0	1.63257	Young (1891–1910)	0	1.63262	Biron (1910)
10	1.6132	„			
17.60	1.59852	„	12.3	1.6090	Gladstone (1891) (Perkin's sample)
20	1.5939	„			
25	1.5843	„	15	1.60365	Perkin (1884)
30	1.5748	„	20	1.5939	Morino (1933)
40	1.5557	„			
			20	1.5940	Biron (1910)
0	1.6325	Cowley and Partington (1936)	20	1.5940	Eftring (1938)
20	1.5941	„	20	1.5940	Michielewicz (1938)
40	1.5557	„			
			25	1.58445	Zmaczynski (1936)
19.35	1.5955	Patterson and Thomson (1908)	25	1.58452	Scatchard, Wood and Mochel (1946)
30.4	1.5742	„			
15.67	1.60258	Egerton and Lee (1923)	25	1.58454	Le Fevre and Le Fevre (1936)
16.10	1.60182	„			
16.49	1.60100	„	25	1.58458	Hubbard (1910)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0	1329	B.E. (1926)	20.00	965	Titani (1927)
15	1038	"	30.00	843	"
30	845	"	40.00	739	"
			50.00	651	"
10.01	1132	Kolossowski (1925)	60.00	585	"
13.53	1075	"	70.00	527	"
15.05	1048	"	80.00	466	"
18.13	1004	"	90.00	426	"
20.20	976	"	100.00	383	"
24.62	912	"	110.00	352	"
30.00	850	"	120.00	322	"
36.93	778	"	130.00	299	"
39.90	752	"	140.00	276	"
42.74	728	"	150.00	255	"
			160.00	234	"
25	887.6	Lewis (1924)	170.00	219	"
			180.00	201	"

Surface tension

t°	γ		t°	γ	
15	27.36	B.E. (1926)	0	29.38	Harkins and Cheng (1921)
20	26.76	"	10	28.05	"
30	25.57	"	20	26.70	"
			30	25.54	"
20	26.77	Desreux (1935)	40	24.41	"
			50	23.22	"
			60	22.38	"

Refractive index

t°	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.46005	1.46305	1.46338	1.46882	1.46970	1.47405	1.47530	B.E. (1926)
$\frac{dn}{dt}$	0.00054	55	55	—	56	—	56	"
20	—	1.46044	—	—	—	—	—	Zmaczynski (1936)
25	—	1.45759	—	—	—	—	—	"
$\frac{dn}{dt}$	—	0.00057	—	—	—	—	—	"
15	—	1.46325	—	—	—	—	—	Pahlavouni (1927)
20	—	1.4602	—	—	—	—	—	Fischer and Reichel (1943)
20	—	1.46023	—	—	—	—	—	Stearn and Smyth (1934)
20	—	1.46026	—	—	—	—	—	Smyth and Engel (1929)
20	—	1.46036	—	—	—	—	—	Davies (1936)
25	1.45461	1.45732	—	—	1.46400	—	1.46954	Hubbard (1910)
25	—	1.4576	—	—	—	—	—	Michielewicz (1938)

Dielectric constant

t°	ε		t°	ε	
20	2.2360	Davies (1936)	25	2.2270	Le Fevre (1938)
25	2.2267	,,	40	2.2003	,,
0	2.275	Cowley and Partington	50	2.1825	,,
20	2.234	,, (1936)	60	2.1650	,,
40	2.195	,,	70	2.1478	,,
−10	2.2930	Le Fevre (1938)	20	2.2488	$\frac{d\varepsilon}{dt} = -0.0020$ Piette (unp.)
0	2.2734	,,			
15	2.2447	,,			

Heat constants

Specific heat: Stull (1937)

t°	c_p	t°	c_p	t°	c_p
−183.16	0.1005	−103.16	0.1420	−23.16	0.1976
−173.16	0.1053	− 93.16	0.1480	−13.16	0.2003
−163.16	0.1093	− 83.16	0.1536	− 3.16	0.2026
−153.16	0.1142	− 73.16	0.1596	+ 6.84	0.2041
−143.16	0.1190	− 63.16	0.1655	16.84	0.2054
−133.16	0.1247	− 53.16	0.1718	26.84	0.2063
−123.16	0.1303	− 43.16	0.1779	36.84	0.2067
−113.16	0.1364	− 33.16	0.1872	46.84	0.2070
25	0.2066	Vold (1937)			

Heat of vaporisation	(B.P.) 46.61 cal 15°/g	Pitzer (1941)
Heat of transition	9.258 ,,	Staveley and Gupta (1949)
Heat of melting	5.085 ,,	,,

TETRABROMOMETHANE or CARBON TETRABROMIDE CBr_4

Constants

Melting point

90°1	Frederick and Hildebrand (1939)
91°0	Van der Werf, Davidson and Michaelis (1948)

Transition point

46°85	Sohier (1931)	46°91	Rothmund (1897)
46°9	Frederick and Hildebrand (1939)	47°0	Verstraete (1934)

Heat of transition	4.282 cal 15°/g	Frederick and Hildebrand (1939)
Heat of melting	2.85 ,,	,,

MONOFLUOROTRICHLOROMETHANE $CFCl_3$

Constants

Critical constants

t° cr.	p cr. atm.	d cr.	
198	43.2	0.554	Benning and Mac Harness (1939)

Isotherms: see Benning and Mac Harness (1940)

Saturated vapour pressure

t°	p mm	t°	p mm	
−36.673	47.35	10.362	463.46	Osborne, Garner, Doescher and Yost
−21.825	108.15	15.108	556.15	,, (1941)
− 6.887	223.60	20.105	664.18	,,
+ 2.352	354.61			,,

Boiling point: 23°7 Benning and Mac Harness (1939)

Melting point: −110°48 Osborne, Garner, Doescher and Yost (1941)
−111° Benning and Mac Harness (1939)

Specific heat: Osborne, Garner, Doescher and Yost (1941) (M.W. 137.38)

t°	c_p	t°	c_p	t°	c_p
C. −258.42	0.02221	−221.09	0.07941	L. −102.61	0.1906
−257.33	0.02560	−216.38	0.08225	− 93.71	0.1920
−256.03	0.02930	−215.49	0.08276	− 86.55	0.1934
−254.09	0.03488	−211.47	0.08523	− 73.40	0.1947
−251.82	0.04068	−206.40	0.08836	− 63.06	0.1964
−249.64	0.04593	−201.06	0.09142	− 52.94	0.1978
−247.42	0.05062	−195.37	0.09506	− 42.97	0.1985
−244.89	0.05513	−189.16	0.09863	− 32.82	0.2010
−241.95	0.05974	−182.51	0.1027	− 22.82	0.2026
−238.65	0.06392	−175.82	0.1067	− 13.26	0.2043
−234.94	0.06785	−173.44	0.1107	− 3.83	0.2060
−231.06	0.07147	−163.38	0.1145	+ 5.47	0.2077
−226.38	0.07541	−157.64	0.1182	14.66	0.2095

DIFLUORODICHLOROMETHANE CF_2Cl_2

Constants

Critical constants

t° cr.	p cr. atm.	d cr.	
111.5	39.56	0.555	Bichowsky and Gilkey (1931)

Saturated vapour pressure

t°	p atm.	t°	p atm.	t°	p atm.	
−70	0.1217	0	3.045	70	18.48	Gilkey, Gerard and Bixler
−60	0.2240	10	4.174	80	22.54	„ (1931)
−50	0.3870	20	5.592	90	27.20	„
−40	0.6340	30	7.337	100	32.58	„
−30	0.9915	40	9.456	110	38.58	„
−20	1.490	50	11.99	111.5	39.56	„
−10	2.162	60	14.98			„

Densities of the liquid and the saturated vapour

t°	L.	V.	
−40	1.517	0.004097	Bichowsky and Gilkey (1931)
−30	1.486	0.006199	„
−20	1.456	0.009037	„
−10	1.425	0.01280	„
0	1.393	0.01765	„
10	1.362	0.02379	„
20	1.329	0.03149	„
30	1.293	0.04111	„
40	1.255	0.05313	„
50	1.213	0.06856	„
60	1.165	0.0875	„
70	1.115	0.111	„
80	1.056	0.142	„
90	0.988	0.182	„
100	0.898	0.242	„
110	0.725	0.390	„

Heat of vaporisation cal 15°/g

t°	c_p	t°	c_p	t°	c_p	
−29.8	40.4	+23	33.9	+28	32.8	Buffington and Fleischer (1931)

B. HALOGENATED DERIVATIVES OF ETHANE

ETHYL FLUORIDE C_2H_5F

This compound is prepared synthetically from potassium fluoride and diethylsulphate.

Constants: Booth and Swinehart (1935)

Critical constants

t° cr.	p cr. atm.
102.16	49.62

Saturated vapour pressure

t°	p atm.	t°	p atm.	t°	p atm.	t°	p atm.
25.65	9.20	51.65	17.77	78.58	31.79	100.99	48.87
33.45	10.86	60.64	21.92	88.22	38.36	101.79	49.48
43.55	14.58	69.73	26.49	95.39	41.92	101.97	49.49

ETHYL CHLORIDE C_2H_5Cl

Constants: B.E. (1937)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−55.877	22.45	−19.994	188.41	+ 3.448	538.99	Gordon and Giauque
−43.644	50.45	−13.479	257.86	6.491	608.30	„ (1948)
−35.441	82.45	− 7.636	336.61	10.490	710.37	„
−28.085	124.13	− 1.878	432.19	12.511	766.83	„
−32.0	98.30	+30.0	1398.98	92.0	7362.30	Regnault (1862)
− 1.0	446.30	61.0	3492.32			„
8.75	661.4	16.7	889.3	17.7	921.5	Schacherl (1880)
11.0	719.9	17.1	905.4	18.9	958.5	„
12.0	741.2	17.3	909.3	19.1	962.1	„
13.4	786.6	17.4	913.0	20.5	1012.8	„
14.0	800.4	17.5	914.7	23.5	1105.7	„
16.3	874.7	17.6	918.7			„
44.6	2219.2	122.7	13794.0	170.45	30704.0	Berthoud (1917)
66.4	4035.6	136.7	17476.4	175.0	33789.6	„
83.3	6323.2	149.0	21812.0	182.4	36685.2	„
98.1	8481.6	162.0	26866.0	187.2	39307.2	„
111.3	11240.4	170.2	30628.0			„

Boiling point

12°28	(interp.) GORDON and GIAUQUE (1948)	12°4	FUCHS (1930)
12°3	$\frac{dt}{dp}$ *(10 mm);* 0°41 B.E. (1937)	12°4	LECAT (passim)
12°33	(interp.) SCHACHERL (1880)	12°5	BECKMANN (1907)
		12°5	(interp.) REGNAULT (1862)

Freezing point

−136°4	B.E. (1937)	−138°30	GORDON and GIAUQUE (1948)

Density

t°	d	
0	0.92390	B.E. (1937)
10	0.90280	„

Viscosity

t°	$\eta \cdot 10^5$	
5	292	B.E. (1937)
10	279	„

Surface tension

t°	γ	
5	21.20	B.E. (1937) and HENNAUT-ROLAND and LEK (1931)
10	20.64	„ „

Refractive index: $n_D^{0°}$ 1.3790 FUCHS (1930)

Heat constants: GORDON and GIAUQUE (1948)

Specific heat

t°	c_p	t°	c_p	t°	c_p
C. −258.55	0.0186	−198.40	0.1848	−67.66	0.3548
−256.02	0.0299	−193.14	0.1950	−62.23	0.3553
−253.11	0.0423	−187.43	0.2007	−56.38	0.3574
−249.48	0.0560	−181.60	0.2065	−50.42	0.3577
−245.67	0.0699	−175.61	0.2162	−44.56	0.3599
−241.70	0.0832	−169.36	0.2291	−38.85	0.3605
−237.77	0.0958	−162.91	0.2430	−33.33	0.3619
−234.07	0.1080	−157.20	0.2585	−28.59	0.3636
−230.39	0.117	−152.02	0.2764	−22.81	0.3661
−226.49	0.127	−146.28	0.3053	−17.13	0.3686
−222.03	0.136	L. −133.28	0.359	−11.42	0.3698
−217.55	0.148	−127.27	0.3576	− 5.36	0.3725
−212.76	0.1581	−122.01	0.3565	+ 0.57	0.3757
−207.95	0.1671	−110.71	0.3551	+ 6.37	0.3783
−203.32	0.1758	− 87.96	0.3545	+11.37	0.3796

Heat of vaporisation	(B.P.) 91.33 cal 15°/g	*Heat of melting*	16.49 cal 15°/g

ETHYL BROMIDE C_2H_5Br

Concerning the bromide derivatives B.E. usually agree with Skau, except for the densities, which are higher than ours. Skau assigns this divergence to the presence of ether. We believe rather that his sample was contaminated by HBr.; this point has still to be cleared up. It is noteworthy, however, that our freezing points agree perfectly.

Note the existence of an azeotropic mixture with ethyl alcohol (B.P.: 37°6; with 3 % alcohol).

Constants: B.E. (1926). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. atm.	d cr.	
230.8	61.5	0.507	Herz and Neukirch (1923)

Saturated vapour pressure

t°	p mm		t°	p mm	
−24.0	46.80	Regnault (1862)	28.145	525.76	Zmaczynski (1930)
+16.0	330.05	”	33.247	633.90	”
56.0	1340.64	”	43.560	906.1	”
96.0	3927.48	”	48.771	1074.6	”
136.0	9088.95	”	54.018	1268.1	”
			59.300	1489.2	”
0	165.2	Rex (1906)	64.619	1741.0	”
10	256.9	”	69.974	2026.3	”
20	385.9	”	75.365	2347.4	”
30	563.7	”	0.32	165.8	Roland (1928)
			15.02	315.2	”

Boiling point

38°34	Skau and Mac Cullough (1935)	38°4	Zepalova-Michaïlowa (1939)
38°37	Regnault (1862)	38°4	Lecat (passim) and B.E. (1926)
38°386	Zmaczynski (1930)	38°40	Tyrer (1914)
38°4	Young (1921)		

$\frac{dt}{dp}$ *(10 mm)*

0°36	B.E. (1926) and Lecat (passim)	0°381	Zmaczynski (1930)

Freezing point

−118°6	Timmermans (1923)	−118°9	Skau and Mac Cullough (1935)

Constants of state

Density

t°	d		t°	d	
0	1.50136	B.E. (1926)	0	1.50138	TIMMERMANS (1923)
15	1.47080	„	−23	1.54512	„
30	1.44030	„	−63.3	1.62389	„
			−78.5	1.65400	„
			−111.6	1.71881	„

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	418	B.E. (1926)	77.8	233.6	HEYDWEILLER (1896)
30	348	„	100.5	198.2	„
19.2	397.3	HEYDWEILLER (1896)	129.0	161.9	„
19.9	396.8	„	130.0	161.3	„
46.0	303.7	„	160.0	125.3	„

Surface tension

t°	γ	
15	24.83	HENNAUT-ROLAND and LEK (1931)
20	24.15	„
30	22.83	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.42443	1.42470	1.42756	1.42771	1.43304	1.43420	1.43850	1.43976
$\frac{dn}{dt}$	—	0.00055	56	56	—	57	—	58

Dielectric constant

t°	ε		t°	ε	
18	9.444	HARRINGTON (1916)	10	9.71	LE FEVRE (1938)
−30	11.69	LE FEVRE (1938)	25	9.01	„
−20	11.29	„	35	8.59	„
−10	10.68	„			
0	10.19	„			

ETHYL IODIDE C_2H_5I

Ethyl iodide forms an azeotrope with 13 % of ethyl alcohol and boiling at 63° (Lecat, 1918), or at 61°2 (Jana and Gupta, 1914).

New method of purification and criticism of the usual methods of purification. Gand (1943).

Constants: B.E. (1928). — **Polyphasic equilibria**

Saturated vapour pressure

t°	p mm		t°	p mm	
8.0	62.8	Regnault (1862)	−100.06	0.0071	Milazzo (1944)
29.0	162.2	„	−99.26	0.008	„
50.0	364.0	„	−78.46	0.1	„
30	162.6	Smyth and Engel (1929)	−62.66	0.5	„
40	244.8	„	−19.36	14	„
50	355.0	„	+0.04	41.5	„
60	505.9	„	9.34	65	„
0	41.0	Rex (1906)	10.4	68	„
10	68.1	„	20.4	109.6	„
30	166.2	„			

Boiling point

72°18	Robertson and Acree (1913)	72°3	Lecat (passim)
72°27	Schiff (1886)	72°3	Carrara and Coppadoro (1903)
72°30	B.E. (1928)	72°42	Gross and Saylor (1931)
72°3	Rex (1906)	72°5	Young (1921)

$\frac{dt}{dp}$ (10 mm)

0°40	B.E. (1928)	0°42	Lecat (passim)

Freezing point

−110°9	Timmermans (passim)

Constants of state

Density

t°	d		t°	d	
0	1.98065	B.E. (1928)	11	1.9557	Perkin (1896)
15	1.94707	„	15	1.9475	„
30	1.91326	„	25	1.92458	Linebarger (1896)
0	1.98038	Tyrer (1914)			

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	617	B.E. (1928)	15	29.60	HENNAUT-ROLAND and
30	540	,,	20	28.83	,, LEK (1931)
20	593	GARTENMESITER (1890)	30	27.57	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.51158	1.51209	1.51682	1.51711	1.52646	1.52866	1.53618	B.E. (1928)
$\frac{dn}{dt}$	0.00060	62	63	64	64	65	64	

Dielectric constant

t°	ε		t°	ε	
0	8.35	LE FEVRE (1938)	45	7.11	LE FEVRE (1938)
10	8.00	,,	55	6.90	,,
25	7.64	,,	65	6.66	,,
35	7.37	,,			

Specific magnetic rotatory power

11°0	2.2808	PERKIN (1896)	

1,2-DICHLOROETHANE or ETHYLENE DICHLORIDE $(CH_2Cl)_2$

The large discrepancies found in the literature are presumably due to the presence of polyhalogenated derivatives.

Constants: B.E. (1928). — **Polyphasic equilibria**

Saturated vapour pressure

50°	236 mm	ZAWIDZKI (1900)

Boiling point

83°45	$\frac{dt}{dp}$ *(10 mm)*;	0°45	LECAT (passim)	83°5	COULSON, HALES and HERINGTON (1948)
$83°48_3$	,,	$0°420_4$	SMITH and MATHESON (1938)	83°6	SCHIFF (1884)
83°50	,,	0°46	B.E. (1928)		

Freezing point

−35°3	Timmermans (passim)	−35°5	Railing (1939)

Constants of state

Density

t°	d		t°	d	
0	1.28164	B.E. (1928)	20	1.2528	Eftring (1938)
15	1.26000	„	20	1.2529	Coulson, Hales and Herington (1948)
30	1.23831	„	25	1.2453	Sears and Hopke (1949)

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	887	B.E. (1928)	15	32.93	Hennaut-Roland and Lek (1931)
30	730	„	20	32.23	„
			30	30.84	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.44481	1.44517	1.44759	1.44771	1.45257	1.45375	1.45747	1.45866	B.E. (1928)
$\frac{dn}{dt}$	0.00050	50	51	51	52	52	52	52	„
20	—	—	1.4449	—	—	—	—	—	Coulson, Hales and Herington (1948)
20	—	—	1.44507	—	—	—	—	—	Pahlavouni (1927)
20	—	1.44240	—	—	—	—	—	—	Hamai (1933)
$\frac{dn}{dt}$	—	0.000523	—	—	—	—	—	—	„

Heat constants

Heat of melting	21.12 cal 15°/g	Railing (1939)
Heat of combustion	20° (c_v) 2993.3 „	Eftring (1938)

1,1-DICHLOROETHANE or ETHYLIDENE DICHLORIDE $CH_3—CHCl_2$

This product is easy to purify. According to LECAT (1918), it forms with ethyl alcohol an azeotrope with 8 % alcohol, boiling at 54°5.

Constants: B.E. (1926)

Saturated vapour pressure

t°	p mm		t°	p mm	
0	70.1	REX (1906)	20	182.1	REX (1906)
10	115.3	„	30	277.2	„

Boiling point

57°1	HENNE and HUBBARD (1936)
57°25	$\frac{dt}{dp}$ *(10 mm)*; 0°42 LECAT (passim)
57°30	„ 0°42 B.E. (1926)

Freezing point

−97°4	HENNE and HUBBARD (1936)
−97°8	TIMMERMANS

Density

t°	d		t°	d	
0	1.20685	B.E. (1926)	20	1.1755	HENNE and HUBBARD (1936)
15	1.18350	„			
30	1.16010	„	20	1.1760	EFTRING (1938)

Viscosity

t°	$\eta \cdot 10^5$	
15	505	B.E. (1926)
30	430	„

Surface tension

t°	γ	
15	25.32	HENNAUT-ROLAND and LEK (1931)
20	24.75	„
30	23.62	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.41677	1.41735	1.41975	1.41990	1.42421	1.42555	1.42871	1.43030	B.E. (1926)
$\frac{dn}{dt}$	—	0.00052	53	53	—	53	—	53	„
20	—	1.41385	1.41638	—	—	1.42213	—	—	HENNE and HUBBARD (1936)

The disagreement between our values and those of HENNE and HUBBARD is unaccountable.

1,2-DIBROMOETHANE or ETHYLENE DIBROMIDE $(CH_2Br)_2$

This compound must be purified by fractional fusion. The best criterion of purity is the freezing point.

Constants: B.E. (1926). — **Polyphasic equilibria**

Boiling point

131°6	Beckmann (1890)	131°70	$\frac{dt}{dp}$ *(10 mm):* 0°48 B.E. (1926)
131°65	$\frac{dt}{dp}$ *(10 mm);* 0°48 Lecat (passim)		

Freezing point

9°93	Railing (1939)	9°97	Leblanc and Möbius (1933)
9°95	Scheuer (1910)	9°975	Moles (1912)
9°95	Desreux (1935)	10°00	B.E. (1926)
9°95	Deffet (1935)	10°012	Biron (1912)

Melting curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²
9.95	1	28.00	733
15.00	201	32.00	888
20.00	405	34.50	988
25.00	610	38.00	(1130)

Constants of state

Density

t°	d		t°	d	
15	2.1911	B.E. (1926)	10.5	2.2008	Gladstone (1891)
30	2.1597	„	20	2.1804	Biron (1912)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	1880	B.E. (1926)	67.3	922	Scheuer (1910)
30	1490	„	82.2	750	„
25	1605	Dunstan, Hilditsch and Thole (1913)	99.0	648	„

Surface tension

t°	γ		t°	γ	
15 20	39.66 38.91	HENNAUT-ROLAND and „ LEK (1931)	30	37.61	HENNAUT-ROLAND and LEK (1931)
			20	38.91	DESREUX (1935)

Refractive index

t°	Hα	D	He y.	Hβ	Hγ	
15	1.53743	1.54160	1.54167	1.55168	1.56024	B.E. (1926)
$\frac{dn}{dt}$	0.00058	58	58	58	58	„

Heat constants

Specific heat: LE BLANC and MÖBIUS (1933)

t°	c_p	t°	c_p	t°	c_p
C. 4.60	0.1310	L. 10.18	0.1768	16.20	0.1721
6.61	0.1311	11.45	0.1748	18.20	0.1714
7.53	0.1311	14.42	0.1728	25.37	0.1716

Heat of melting	13.79 cal 15°/g	RAILING (1939)

VERHULST and JUNGERS (1949); WUYTS and JUNGERS (1949) and D'HONDT and JUNGERS (1949) have studied the deutero di and tribromomethanes.

1,1,1-TRIFLUOROETHANE or METHYLFLUOROFORM $CF_3—CH_3$

Constants: RUSSEL JR., GOLDING and YOST (1944)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm
−99.546	26.17	−70.947	213.14	−54.315	538.79
−87.303	70.62	−64.321	314.91	−50.618	648.04
−77.73	138.41	−58.945	423.26	−47.370	757.62

Boiling point	*Melting point*
−47°305 (calc.)	−111°34

Specific heat: (M.W. 84.044)

t°	c_p	t°	c_p	t°	c_p
C. −260.835	0.01836	−239.082	0.09133	−167.005	0.1813
−259.947	0.02123	−238.680	0.09225	−159.171	0.1904
−259.879	0.02152	−235.312	0.09942	−151.203	0.2002
−258.579	0.02681	−234.430	0.1009	−143.265	0.2116
−258.535	0.02699	−231.269	0.1068	−135.306	0.2253
−257.125	0.03251	−226.977	0.1144	−131.455	0.2330
−257.099	0.03262	−222.334	0.1210	−127.192	0.2435
−255.431	0.03932	−217.348	0.1275		
−255.222	0.04019	−216.107	0.1290	L. −107.753	0.2892
−253.367	0.04746	−212.116	0.1335	−107.352	0.2895
−252.965	0.04895	−209.957	0.1359	−102.652	0.2907
−250.791	0.05697	−206.581	0.1396	−101.159	0.2912
−250.453	0.05822	−203.462	0.1429	− 95.575	0.2930
−248.676	0.06646	−196.533	0.1502	− 93.950	0.2936
−247.728	0.06762	−189.250	0.1577	− 86.128	0.2964
−245.291	0.07511	−182.265	0.1647	− 77.638	0.3006
−245.093	0.07564	−181.519	0.1657	− 69.471	0.3035
−242.354	0.08321	−174.696	0.1726	− 60.714	0.3077
−242.218	0.08358	−173.618	0.1737	− 52.417	0.3123

Heat of vaporisation	*Heat of melting*	*Heat of transition*
(−48°76/0.9339 atm) 54.52 cal 15°/g	17.61 cal 15°/g	0.8400 → 0.8439 cal 15°/g

1,1,2-TRICHLOROETHANE $CH_2Cl—CHCl_2$

Constants

Boiling point

113°3	HENNE and HUBBARD (1936)
113°5	TIMMERMANS (1913)
113°65	LECAT

Freezing point

−36°65	TIMMERMANS (1913)
−37°4	HENNE and HUBBARD (1936)

Density

t°	d	
20	1.4405	DESREUX (1935)
20	1.4411	HENNE and HUBBARD (1936)

Surface tension

t°	γ	
20°	33.57	DESREUX (1935)

Refractive index

t°	Hα	D	Hβ	
20	1.46798	1.47064	1.47731	HENNE and HUBBARD (1936)

1,1,1-TRICHLOROETHANE or METHYLCHLOROFORM CH_3-CCl_3

Constants: B.E. (unp.)

Saturated vapour pressure

t°	p mm	t°	p mm	
−5.364	28.8	11.304	69.3	Rubin, Levedahl and Yost (1944)
+5.109	50.5	16.923	91.2	

Boiling point

73°9	Henne and Hubbard (1936)
74°0	$\frac{dt}{dp}$ *(10 mm):* 0°44 B.E. (unp.)
74°0	Turkevich and Smyth (1940)

Freezing point

−32°2	Van de Vloed (1938)
−32°7	Turkevich and Smyth (1940)
−32°96	Rubin, Levedahl and Yost (1944)

Transition point: −48°96 Rubin, Levedahl and Yost (1944)

Density

t°	d	
0	1.37068	B.E. (unp.)
15	1.34587	,,
30	1.32096	,,

Viscosity

t°	$\eta \cdot 10^5$	
15	903	B.E. (unp.)
30	725	,,

Surface tension

t°	γ	
15	26.17	B.E. (unp.)
20	25.56	,,
30	24.25	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.43787	1.43832	—	1.44097	1.44592	1.44711	1.45099	—	B.E. (unp.)
$\frac{dn}{dt}$	0.00051	51	—	52	53	52	55	—	,,
20	—	—	1.4379	—	—	—	—	—	Turkevich and Smyth (1940)

Specific heat: Rubin, Levedahl and Yost (1944) (M.W. 133.415)

t°	c_p	t°	c_p	t°	c_p
C. I −260.87	0.0105	−199.94	0.09641	−63.65	0.2348
−259.83	0.0142	−192.07	0.1026	−60.26	0.2544
−258.79	0.0175	−183.57	0.1091	−57.15	0.2855
−257.68	0.0214	−174.59	0.1157	−54.35	0.3385
−255.66	0.0264	−171.32	0.1181	C. II −47.03	0.2600
−253.55	0.0322	−163.30	0.1235	−44.25	0.2818
−251.48	0.0373	−155.42	0.1296	−42.33	0.3050
−249.12	0.04277	−147.43	0.1358	L. −27.76	0.2499
−246.14	0.05012	−139.32	0.1416	−21.55	0.2508
−242.80	0.05593	−131.30	0.1474	−15.36	0.2516
−239.33	0.06128	−116.11	0.1593	− 9.35	0.2527
−235.41	0.06637	−108.90	0.1649	+ 2.69	0.2541
−230.73	0.07136	−101.89	0.1695	8.69	0.2553
−225.56	0.07661	− 95.08	0.1755	14.54	0.2565
−219.76	0.08164	− 82.94	0.1863	20.55	0.2574
−213.60	0.08614	− 77.87	0.1947	26.43	0.2585
−207.33	0.09094				

1,1-DIFLUORO-2-BROMOETHANE $CH_2Br—CHF_2$

Constants

Density

t°	d	
10.5	1.83685	Swarts (1923)
20	1.8169	Desreux (1935)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
20.05	784	Swarts (1931)	40	620.5	Swarts (1931)
30	696.5	„	50.45	555	„

Surface tension: 20° 27.02 Desreux (1935)

Refractive index

t°	Hα	D	Hβ	Hγ	
10.5	1.39300	1.39400	1.39772	1.40470	Swarts (1923)

1,1,2,2-TETRACHLOROETHANE (ACETYLENE TETRACHLORIDE)

$(CHCl_2)_2$

Constants: B.E. (1926)

Boiling point

146°2	EFTRING (1938)
146°2	$\frac{dt}{dp}$ *(10 mm);* 0°51 LECAT (passim)
146°20	„ 0°50 B.E. (1926)

Freezing point: —42°5 TIMMERMANS (passim)

Density

t°	d		t°	d	
0	1.62640	B.E. (1926)	17	1.5995	VELEY (1909)
15	1.60255	„	22.5	1.5908	WALDEN and SWINNE
30	1.57860	„	25	1.5869	„ (1913)

Viscosity

t°	$\eta \cdot 10^5$	
15	1844	B.E. (1926)
30	1456	„
10	2059	DRUCKER and KASSEL (1911)

Surface tension

t°	γ	
20	36.04	EFTRING (1938)
40	33.30	„

Refractive index

t°	Hα	D	He y.	Hβ	Hγ	
15	1.49392	1.49678	1.49680	1.50381	1.50654	B.E. (1926)
$\frac{dn}{dt}$	0.00051	51	—	51	51	„
17	—	1.495587	—	—	—	VELEY (1909)
18.5	1.49209	1.49490	—	1.50188	—	COTTON and MOUTON (1913)

Heat of combustion	20° (c_v) 1370.8 cal 15°/g	EFTRING (1938)

1,1,2,2-TETRABROMOETHANE (ACETYLENE TETRABROMIDE) ($(CHBr_2)_2$)

Constants

Boiling point: 134° SWARTS (1897)

Melting point: 0° TIMMERMANS (1913)

0°13 LESPIEAU (1919)

Density

t°	d	t°	d	
19.3	2.9656	50.0	2.8970	WALDEN and SWINNE (1913)
25.0	2.9529	73.5	2.8444	„
46.0	2.9056	100.7	2.7834	„
		20	2.9656	SWARTS (1897)

Refractive index $n_D^{20°}$: 1.63795 SWARTS (1897)

1-FLUORO-1,2,2-TRICHLOROETHANE CHClF—$CHCl_2$

Constants

Density

t°	d	
17.2	1.5492	SWARTS (1923)
20	1.5393	DESREUX (1935)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
20	1070	SWARTS (1931)	50	727	SWARTS (1931)
30	929	„	60	651	„
40	819	„			

Surface tension: 20° 29.95 DESREUX (1935)

Refractive index

t°	Hα	D	Hβ	Hγ	
17.2	1.4377	1.4400	1.4457	1.45073	SWARTS (1923)

1,1-DIFLUORO - 2,2-DICHLOROETHANE $CHCl_2—CHF_2$

Constants

Density: 16°4 1.4945 Swarts (1923)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
20	713	50	494	Swarts (1931)
30	626	55	468	„
40	554			„

Refractive index

t°	Hα	D	Hβ	Hγ	
16.4	1.38108	1.38303	1.39770	1.39216	Swarts (1923)

	1,1-DICHLORO-1,2-DIBROMOETHANE $CH_2Br—CCl_2Br$		1,1-DICHLORO-1,2,2-TRIBROMOETHANE $CHBr_2—CCl_2Br$	
Constants: Van de Walle (1925)				
Boiling point	175°		210°	
Melting point	−66°85	Timmermans	+16°8	
Density	t°	d	t°	d
	0	2.2998	15	2.6315
	15	2.2695	30	2.6009
	30	2.1957		
Viscosity	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$
	0	5361	15	13457
	15	3755	30	8385
	30	2678		
Refractive index	15°	—	15°	30°
Hα	1.5525	—	1.60138	1.59456
D	1.55930	—	1.60724	1.60035
Hβ	1.56917	—	1.62095	1.61089

PENTACHLOROETHANE C_2HCl_5

Constants: B.E. (1926)

Boiling point: 162° $\frac{dt}{dp}$ *(10 mm):* 0°54 B.E. (1926) and LECAT (passim)

Freezing point: –29°0 B.E. (1926) and DEFFET (1935)

Melting curve: DEFFET (1935)

t°	p kg/cm²	t°	p kg/cm²
–29.0	1	–20.0	406
–26.5	113	–14.0	680
–24.2	213	– 7.5	972

Density

t°	d	
0	1.71100	B.E. (1926)
15	1.68813	,,
30	1.66530	,,

Viscosity

t°	$\eta \cdot 10^5$	
15	2751	B.E. (1926)
30	2070	,,

Surface tension

t°	γ	
15	35.30	HENNAUT-ROLAND and LEK (1931)
20	34.72	,,
30	33.58	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.50198	1.50250	1.50542	1.50545	1.51121	1.51270	1.51702	1.51870
$\frac{dn}{dt}$	—	0.00046	46	46	—	47	—	47

HEXACHLOROETHANE C_2Cl_6

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
C. 62.1	6.0	149.0	248	191.7	904	Van der Lee (1935)
72.6	10	153.4	291	193.5	941	„
73.7	11.5	154.9	304	197.9	1037	„
83.4	18	158.2	334	198	1052	„
96.7	32	158.8	348	200.2	1094	„
108.9	53	165.0	408	204.3	1190	„
118.0	80	170.5	502	208.1	1302	„
118.3	81	173.2	535	212.6	1391	„
119.9	83	173.6	545	213.5	1444	„
123.9	102	177.0	607	214.3	1457	„
128.3	120	180.3	672	214.8	1497	„
129.1	123	180.7	678	216.2	1539	„
131.0	131	182.6	722	224.2	1801	„
133.3	143	183.4	737	228.8	1965	„
136.5	161	184.8	769	234.8	2159	„
138.4	167	L. 189.6	869	239.1	2380	„
C. 12.94	0.20	61.74	5.1	110.34	57.2	Ivin and Dainton
30.44	0.60	64.94	6.1	117.14	74.8	„ (1947)
34.34	0.80	67.64	7.15	132.34	137.8	„
40.74	1.25	76.64	11.7	139.24	175.0	„
44.74	1.65	79.54	13.75	149.84	254.7	„
47.34	1.85	90.04	22.6	161.44	373.0	„
53.04	2.85	99.94	36.2	174.44	559.3	„

Boiling point: 184°4 Van der Lee (1935)
184°8 Lecat

Triple point

−186°8	Van der Lee (1935)
−186°8	Wiebenga (1935)

Transition points

Rhombic → Triclinic:	43°6	Wiebenga (1935)
	45°	Steinmetz (1905)
Triclinic → Cubic:	71°	Steinmetz (1905)
	71°1	Wiebenga (1935)
	71°6	Pascal (1912)
	72°	Ivin and Dainton (1947)

Heat of combustion	20° (c_v) 721.3 cal 15°/g	Eftring (1938)

1,2-DIFLUOROTETRACHLOROETHANE $(CCl_2F)_2$

Constants: Locke, Brode and Henne (1934)

Boiling point: 92°8 *Melting point:* 24°65

Density

t°	d	
25	1.64470	
35	1.62516	

Refractive index

t°	Hα	D	Hβ
25	1.41100	1.41297	1.41823
35	1.40656	1.40831	1.41368
$\frac{dn}{dt}$	0.00044	47	45

1,1,2-TRIFLUORO-1,2,2-TRICHLOROETHANE $CF_2Cl—CCl_2F$

Constants

Critical constants

t° cr.	p cr. atm.	d cr.	
214.1	33.7	0.576	Benning and Mac Harness (1939)

Isotherms: see Benning and Mac Harness (1940)

Boiling point

47°4	Swarts (1931)
47°6	Benning and Mac Harness (1939)

Melting point

−35°	Benning and Mac Harness (1939)
−36°4	Swarts (1931)
−36°4	Locke, Brode and Henne (1934)

Density

t°	d		t°	d	
0	1.6200	Locke, Brode and Henne	35	1.53982	Locke, Brode and Henne
25	1.56354	„ (1934)	0	1.6200	Swarts (1931) (1934)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
20	698	40	546.5	Swarts (1931)
30	614	45	516	„

Refractive index

t°	Hα	D	Hβ	.
25	1.35413	1.35572	1.35981	Locke, Brode and Henne (1934)
35	1.34933	1.35124	1.35488	„
$\frac{dn}{dt}$	0.00048	45	49	„

C. HALOGENATED DERIVATIVES OF PROPANE

n-PROPYL CHLORIDE C_2H_5—CH_2Cl

Constants: B.E. (1930)

Critical constants: t°cr: 230.05; p cr. atm: 45.18 Berthoud (1917)

Saturated vapour pressure

t°	p atm.	t°	p atm.	
45.55	0.956	174.8	20.28	Berthoud (1917)
64.2	1.86	188.2	24.89	„
92.5	4.03	199.5	29.49	„
111.0	6.11	207.8	33.13	„
132.6	9.74	214.65	36.32	„
150.2	13.56	225.35	42.08	„
165.55	17.54			„

Boiling point

46°60	$\frac{dt}{dp}$ *(10 mm);* 0°37 B.E. (1930)	46°80	(interp.) Berthoud (1917)
46°65	$\frac{dt}{dp}$ *(10 mm);* 0°38 Lecat (passim)	47°17	Eftring (1938)

Freezing point

−122°3	Martin and Humphrey (1947)	−122°8	B.E. (1930)

Density

t°	d		t°	d	
0	0.91686	B.E. (1930)	30	0.87994	B.E. (1930)
15	0.89846	„	20	0.8924	Eftring (1938)

Viscosity

t°	$\eta \cdot 10^5$	
15	372	B.E. (1930)
30	318	„

Surface tension

t°	γ	
15	22.45	B.E. (1930)
20	21.78	„
30	20.48	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.38884	1.38924	1.39142	1.39544	1.39645	1.39947	1.40059
$\frac{dn}{dt}$	0.00053	52	54	54	56	57	58

Heat of combustion	20° (c_v) 6210.4 cal 15°/g	**Eftring** (1938)

Iso-PROPYL CHLORIDE $(CH_3)_2CHCl$

Constants: B.E. (1928)

Saturated vapour pressure

t°	p mm	t°	p mm	
0	191.7	20	435.5	**Rex** (1906)
10	291.5	30	629.7	„

Boiling point

34°8	$\frac{dt}{dp}$ *(10 mm)*; 0°34 B.E. (1928)	34°8	**Rex** (1906)
		34°9	**Lecat** (passim)

Freezing point

–117°0	B.E. (1928)

Density

t°	d		t°	d	
0	0.88690	B.E. (1928)	15	0.86812	**Perkin** (1885)
15	0.86797	„	25	0.85503	„
30	0.84910	„			

Viscosity

t°	$\eta \cdot 10^5$	
15	335	B.E. (1928)
30	286	"

Refractive index

t°	H_α	D	He y.	H_β
15	1.37900	1.38110	1.38141	1.38620
$\frac{dn}{dt}$	0.00055	56	56	56

n-PROPYL BROMIDE C_2H_5—CH_2Br

n-Propyl bromide gives with *n*-propyl alcohol an azeotrope with 10 % of alcohol boiling at 69°75, according to Holley (1902) or with only 9 % alcohol, boiling at 69°2, according to Lecat (1918).

Constants: B.E. (1926)

Saturated vapour pressure

t°	p mm	t°	p mm	
0	41.6	20	110.8	Rex (1906)
10	68.19	30	170.6	"

Boiling point

70°92	Schiff (1884)	71°00	Lecat (passim) and B.E. (1926)
70°97	Skau and Mac Cullough (1935)	71°00	Zander (1882)
		71°00	Hilditch and Dunstan (1911)

$\frac{dt}{dp}$ *(10 mm)*

0°34	B.E. (1926)	0°35	Lecat (passim)

Freezing point

−109°8	Skau and Mac Cullough (1935	−110°0	B.E. (1926)

Density

t°	d		t°	d	
0	1.38455	B.E. (1926)	20	1.3515	Gartenmeister (1890)
15	1.35965	„	25	1.3455	Skau and Mac Cullough (1935)
30	1.33475	„			

Viscosity

t°	$\eta \cdot 10^5$	
15	539	B.E. (1926)
30	459	„

Surface tension

t°	γ		t°	γ	
15	26.48	Hennaut-Roland and Lek (1931)	30	24.59	Hennaut-Roland and Lek (1931)
20	25.85	„	10	27.08	Schiff (1884)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.43379	1.43440	1.43695	1.43700	1.44248	1.44384	1.44784	1.44949
$\frac{dn}{dt}$	—	0.00052	52	—	—	53	—	53

Iso-PROPYL BROMIDE $(CH_3)_2CHBr$

This compound gives with *iso*-propyl alcohol an azeotrope with 12 % of *iso*-propyl alcohol, boiling at 57°8: (Lecat, 1918).

Constants: B.E. (1928)

Saturated vapour pressure

t°	p mm		t°	p mm	
0	69.1	Rex (1906)	20	175.4	Rex (1906)
10	111.4	„	30	264.2	„

Boiling point

59°35	$\frac{dt}{dp}$ *(10 mm)*; 0°37 B.E. (1928)	59°41	SKAU and MAC CULLOUGH (1935)
59°4	$\frac{dt}{dp}$ *(10 mm)*; 0°36 LECAT (passim)		

Freezing point

−89°0	B.E. (1928)	−90°0	SKAU and MAC CULLOUGH (1935)

Density

t°	d		t°	d	
0	1.34715	B.E. (1928)	30	1.29720	B.E. (1928)
15	1.32223	„	25	1.3063	SKAU and MAC CULLOUGH (1935)

Viscosity

t°	$\eta \cdot 10^5$	
15	536	B.E. (1928)
30	437	„

Surface tension

t°	γ	
15	23.56	HENNAUT-ROLAND and LEK (1931)
20	22.90	„
30	21.74	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.42540	1.42566	1.42847	1.42865	1.43403	1.43520	1.43959	1.44045
$\frac{dn}{dt}$	0.00056	56	57	57	58	58	58	58

n-PROPYL IODIDE C_2H_5—CH_2I

This compound gives with *n*-propyl alcohol an azeotrope with 30 % of alcohol, boiling at 90°2. (LECAT; 1918).

Constants: B.E. (1934)

Saturated vapour pressure: see MILAZZO (1944)

Boiling point

102°4	LECAT (passim)	102°5	DOBRINER (1888)
102°45	$\frac{dt}{dp}$ *(10 mm)*; 0°47 B.E. (1934)	102°5	ZANDER (1882)

Freezing point: — 98°7 B.E. (1934)

Density *Viscosity*

t°	d		t°	$\eta \cdot 10^5$	
0	1.78673	B.E. (1934)	15	837	B.E. (1934)
15	1.75840	„	30	670	„
30	1.72997	„			

Surface tension

t°	γ		t°	γ	
15	30.11	Bodson (1937)	14	30.20	Schiff (1884)
20	29.56	„	40	27.07	„
30	28.47	„			
40	27.40	„			

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ
15	1.50386	1.50448	1.50890	1.51738	1.51925
$\frac{dn}{dt}$	0.00060	60	62	63	65

Iso-PROPYL IODIDE $(CH_3)_2CHI$

Constants: B.E. (1934)

Saturated vapour pressure: see Milazzo (1944)

t°	p mm	
0	21.1	Rex (1906)
20	56.4	„
30	88.4	„

Boiling point

89°45	$\frac{dt}{dp}$ *(10 mm):* 0°45	Lecat (passim)
89°45		B.E. (1934)
89°5		Hughes and Shapiro (1937)

Freezing point: −90°0 Timmermans (passim)

Density

t°	d	
0	1.74246	B.E. (1934)
15	1.71371	„
30	1.68503	„

Viscosity

t°	$\eta \cdot 10^5$	
15	732	B.E. (1934)
30	620	„

Surface tension

t°	γ	
20	27.42	Bodson (1937)
30	26.13	„
40	24.87	„
50	23.63	Bodson (1937)
60	22.37	„
70	21.12	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.49698	1.49763	1.50224	1.51111	1.51321	1.52003
$\frac{dn}{dt}$	0.00058	58	58	59	59	59

PROPYLENE DICHLORIDE or 1,2-DICHLOROPROPANE

$CH_3—CHCl—CH_2Cl$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
15	33.0	50	154.7	85	539.1	Nelson and Young (1933)
20	42.0	55	188.0	90	630.5	„
25	54.0	60	227.4	95	733.5	„
30	67.5	65	273.0	96	754.0	„
35	84.0	70	326.8	99.7	847.1	„
40	103.5	75	388.0			„
45	126.3	80	459.3			„

Boiling point

95°6	Eftring (1938)
96°25	Lecat (passim)
96°4	Nelson and Young (1933)

Density *Surface tension*

t°	d		t°	γ	
20	1.1545	Nelson and Young (1933)	20	29.42	Eftring (1938)
20	1.1559	Eftring (1938)	40	26.91	„

Refractive index

t°	Hα	Hβ	Hγ	
20	1.43785	1.44593	1.45051	Eftring (1938)

Heat of combustion	20° (c_v) 3963.4 cal 15°/g	Eftring (1938)

Iso-PROPYLIDENE DICHLORIDE or 2,2-DICHLOROPROPANE

$CH_3—CCl_2—CH_3$

Constants: B.E. (1934)

Boiling point

69°88	Eftring (1938)	70°5	$\frac{dt}{dp}$ *(10 mm)*; 0°41 B.E. (1934)
70°4	Lecat (passim)		

Freezing point

−33°8	Turkevich and Smyth (1940)	−34°4	B.E. (1934)

Density

t°	d		t°	d	
0	1.11921	B.E. (1934)	30	1.07767	B.E. (1934)
15	1.09843	„	20	1.0912	Eftring (1938)

Viscosity

t°	$\eta \cdot 10^5$	
15	769	B.E. (1934)
30	619	„

Surface tension

t°	γ		t°	γ	
15	24.30	B.E. (1934)	20	24.07	Eftring (1938)
20	23.62	,,	40	21.53	,,
30	22.53	,,			

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ	
15	1.41501	1.41538	1.41793	1.42241	1.42348	1.42718	—	B.E. (1934)
$\frac{dn}{dt}$	0.00047	47	47	49	49	52	—	,,
20	—	1.41311	—	—	1.42097	—	1.42545	Eftring (1938)

Heat of combustion	20° (c_v) 3955.4 cal 15°/g	Eftring (1938)

TRIMETHYLENE DICHLORIDE or 1,3-DICHLOROPROPANE

$CH_2Cl—CH_2—CH_2Cl$

Constants: Eftring (1938)

Density

t°	d	
20	1.1862	

Surface tension

t°	γ	
20	34.01	
40	31.44	

Refractive index

t°	Hα	Hβ	Hγ	
20	1.44692	1.45506	1.45973	

Heat of combustion	20° (c_v) 3968.4 cal 15°/g	

PROPYLENE DIBROMIDE or 1,2-DIBROMOPROPANE

$CH_3—CHBr—CH_2Br$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	
37.3	15	61.8	50	Kahlbaum and Arndt (1898)
42.5	20	71.4	75	,,
46.8	25	78.4	100	,,
50.6	30	89.2	150	,,
53.9	35	97.2	200	,,
56.8	40	103.8	250	,,
59.4	45	109.6	300	,,

Boiling point *Freezing point*

140°5	Lecat (passim)	−55°35	Timmermans (passim)
141°0	Kahlbaum and Arndt (1898)		

Density

t°	d	
20	1.93326	Kahlbaum and Arndt (1898)

Refractive index

t°	Hα	D	Hβ	Hγ	
20°	1.51659	1.51976	1.52966	1.53736	Kahlbaum and Arndt (1898)

TRIMETHYLENE DIBROMIDE or 1,3-DIBROMOPROPANE

$CH_2Br—CH_2—CH_2Br$

Constants: Serwy (1933)

Boiling point *Freezing point*

166°9	Lecat (passim)	−34°2	Serwy (1933)
167°34	$\frac{dt}{dp}$ (10 mm); 0°50 Serwy (1933)		

Density

t°	d
0	2.01618
15	1.98927
30	1.96238

Viscosity

t°	$\eta \cdot 10^5$
15	2241
30	1746

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.52121	1.52174	1.52546	1.53252	1.53416	1.53932	1.54464
$\frac{dn}{dt}$	0.00048	48	48	49	48	50	—

1,2,3-TRICHLOROPROPANE $CH_2Cl—CHCl—CH_2Cl$

Constants: Eftring (1938)

Boiling point: 156°6

Density

t°	d
20	1.3896

Refractive index

t°	Hα	D	Hβ	Hγ
20	1.48129	1.4836	1.49031	1.49561

Heat of combustion	20° (c_v) 2788.4 cal 15°/g

1,1,1,2,2,3,3-HEPTACHLOROPROPANE $CCl_3—CCl_2—CCl_2H$

Saturated vapour pressure, boiling and freezing points and density: Boeseken and Prins (1911) and Prins (1914)

D. HALOGENATED DERIVATIVES OF BUTANE

BUTYL FLUORIDES

Constants: DESREUX (1935)

	prim. *n*-C_3H_7—CH_2F		*sec.* C_2H_5—CHF—CH_3	
Boiling point	32°48		25°08	
Density	t°	d	t°	d
	0	0.8005	0	0.7884
	15	0.7824	15	0.7700
	20	0.7761		
Viscosity $\eta \cdot 10^5$	20	η: 284.5	15	η: 286.2
Surface tension	20	γ: 17.72	15	γ: 16.93
Refractive index	15	n Hα 1.3404	12	n Hα 1.3350
		D 1.3419		D 1.3366
		Hβ 1.3457		Hβ 1.3403
		Hγ 1.3488		

n-BUTYL CHLORIDE *n*-C_3H_7—CH_2Cl

Constants: B.E. (1930)

Boiling point *Freezing point*

78°5	$\frac{dt}{dp}$ *(10 mm)*; 0°42 LECAT (passim)	−123°1	B.E. (1930)
78°50	„ 0°41 B.E. (1930)		

Density

t°	d		t°	d	
0	0.90838	B.E. (1930)	20	0.8866	VOGEL (1943)
15	0.89197	„	40.9	0.8650	„
30	0.87549	„	60.6	0.8427	„

Viscosity

t°	$\eta \cdot 10^5$	
15	469	B.E. (1930)
30	405	„

Surface tension

t°	γ		t°	γ	
15	24.40	B.E. (1928)	19.0	23.85	Vogel (1943)
20	23.90	„	26.3	23.10	„
30	22.88	„	41.0	21.25	„
			61.6	19.14	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.40237	1.40276	—	1.40499	1.40903	1.40978	1.41331	1.41436	B.E. (1930)
$\frac{dn}{dt}$	0.00050	50	—	51	52	53	54	—	„
20	—	1.39940	1.40223	—	—	1.40730	—	1.41099	Vogel (1943)

Iso-BUTYL CHLORIDE $(CH_3)_2CH—CH_2Cl$

Constants: B.E. (1926)

Saturated vapour pressure: 20° 126.2 mm Hirshberg (1932)

Boiling point

68°81	Eftring (1938)
68°85	$\frac{dt}{dp}$ *(10 mm)*; 0°42 B.E. (1926) and Lecat (passim)

Freezing point: –131°2 B.E. (1926)

Density

t°	d		t°	d	
0	0.89962	B.E. (1926)	30	0.86620	B.E. (1926)
15	0.88290	„	20	0.8776	Eftring (1938)

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	471	B.E. (1926)	15	22.56	Hennaut-Roland and Lek (1931)
30	395	„	20	21.99	„
			30	20.87	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.39829	1.39884	1.40096	1.40100	1.40496	1.40609	1.40902	1.41039
$\frac{dn}{dt}$	—	0.00052	52	52	—	52	—	52

Heat of combustion	20° (c_v) 6929.8 cal 15°/g	Eftring (1938)

Sec.-BUTYL CHLORIDE CH_3—CHCl—C_2H_5

Constants: B.E. (1928)

Saturated vapour pressure

t°	p mm		t°	p mm	
0.32	49.3	Roland (1928)	29.96	193.8	Roland (1928)
10.02	79.95	„	39.85	285.1	„
20.18	127.5	„			

Boiling point *Freezing point*

68°25	$\frac{dt}{dp}$ *(10 mm)*; 0°41 B.E. (1928) and Lecat (passim)	−131°3	(racem.) B.E. (1928)
		−140°0	(active) „
68°25	Eftring (1938)		

Density

t°	d		t°	d	
0	0.89556	(rac) B.E. (1928)	30	0.86210	B.E. (1928)
15	0.87880	„	0	0.89497	(active) „
20	0.87323	„	20	0.8728	Eftring (1938)

Viscosity

t°	$\eta \cdot 10^5$	
15	439	B.E. (1928)
30	363	„

Refractive index

t°	Hα	D	He y.	Hβ	Hγ
15	1.3974	1.3994	1.39975	1.4045	1.4089
$\frac{dn}{dt}$	0.00050	48	—	50	54

Rotatory power

		(α)			(n)
20° Li	(red)	−6.40	He y.	(yellow)	− 8.86
Li	(or.)	−7.86	He g.	(green)	−10.08
Na		−8.48	Li	(blue)	−14.94
			He g.	(violet)	−17.04

Heat of combustion	20° (c_v) 6924.8 cal 15°/g	EFTRING (1938)

Tert.-BUTYL CHLORIDE $(CH_3)_3CCl$

Constants: B.E. (1934)

Boiling point

50°7	$\frac{dt}{dp}$ *(10 mm);* 0°36 B.E. (1934)	50°8	$\frac{dt}{dp}$ *(10 mm);* 0°37 LECAT (passim)

Freezing point

−27°1	B.E. (1934)

Density

t°	d		t°	d	
0	0.86523	B.E. (1934)	30	0.82936	B.E. (1934)
15	0.84739	„			

Viscosity

t°	$\eta \cdot 10^5$	
15	543	
30	439	

Surface tension

t°	γ	
15	20.06	
20	19.56	
30	18.35	

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.38526	1.38557	—	1.38777	1.39188	1.39289	1.39620	B.E. (1934)
$\frac{dn}{dt}$	0.00052	52	—	52	53	53	54	„

n-BUTYL BROMIDE $C_3H_7—CH_2Br$

Constants: B.E. (1926)

Boiling point

101°26	Skau and Mac Cullough (1935)	101°60	B.E. (1926)
101°5	Lecat (passim)	101°60	Van Bogaert (1927)
101°6	Cupp and Rogers (1939)		

$\frac{dt}{dp}$ *(10 mm)*

0°50	Lecat (passim)	0°51	B.E. (1926)

Freezing point

−112°3	Skau and Mac Cullough (1935)	−112°4	B.E. (1926)

Density

t°	d		t°	d	
0	1.30435	B.E. (1926)	15	1.28284	Skau and Mac Cullough (1935)
15	1.28292	„			
30	1.26120	„	25	1.2689	Cupp and Rogers (1939)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	666	B.E. (unp.) (corr. val. 1926)	20	633	Mountford (unp.)
30	567	„	25	591.4	Cupp and Rogers (1939)

Surface tension

t°	γ	
15	27.00	Hennaut-Roland and Lek (1931)
20	26.33	„
30	25.21	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.43926	1.43940	1.44225	1.44241	1.44769	1.44875	1.45290	1.45410	B.E. (1926)
$\frac{dn}{dt}$	—	0.00050	50	50	—	52	—	52	„
25	—	—	1.4373	—	—	—	—	—	Cupp and Rogers (1939)

Iso-BUTYL BROMIDE $(CH_3)_2CH—CH_2Br$

Constants: B.E. (1928)

Boiling point: 91°40 $\frac{dt}{dp}$ *(10 mm):* 0°37 B.E. (1928) and Lecat (passim)

Freezing point: −117°4 Timmermans (passim)

Density *Viscosity*

t°	d		t°	$\eta \cdot 10^5$	
0	1.29410		15	679	
15	1.27197		30	567	
30	1.24980				

Refractive index

t°	Hα	D	He y.	Hβ	Hγ
15	1.43639	1.43901	1.43914	1.44567	1.45131
$\frac{dn}{dt}$	0.00049	50	50	50	52

Sec.-BUTYL BROMIDE (rac. and antipodes) $CH_3—CHBr—C_2H_5$

Constants: B.E. (1934)

Boiling point

91°20	$\frac{dt}{dp}$ *(10 mm);* 0°51 B.E. (1934) and Lecat (passim)	91°3	Houston (1933)
91°24	Skau and Mac Cullough (1935)		

Freezing point

−111°9	B.E. (1934)	−112°1	Skau and Mac Cullough (1935)

Density

t°	d		t°	d	
0	1.28968	B.E. (1934)	25	1.2530	Skau and Mac Cullough (1935)
15	1.26808	„			
30	1.24643	„			

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	618	B.E. (1934)	15	25.85	Hennaut-Roland and
30	526	„	20	25.18	„ Lek (1931)
			30	23.86	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.43619	1.43664	1.43950	1.44485	1.44614	1.45030	1.45199
$\frac{dn}{dt}$	0.00046	46	48	49	49	49	51

Tert.-BUTYL BROMIDE $(CH_3)_3CBr$

Constants: B.E. (1934)

Boiling point: 73°25 $\frac{dt}{dp}$ *(10 mm):* 0°40 B.E. (1934) and Lecat (passim)

Freezing point: −16°2 B.E. (1934)

Density			*Viscosity*			*Surface tension*		
t°	d		t°	$\eta \cdot 10^5$		t°	γ	
0	1.25160		15	883		15	22.96	
15	1.22861		30	702		20	22.45	
30	1.20553					30	21.24	

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.42736	1.42782	1.43071	1.43634	1.43753	1.44205
$\frac{dn}{dt}$	0.00051	51	52	53	52	—

n-BUTYL IODIDE $C_3H_7{-}CH_2I$

Constants: B.E. (1934)

Saturated vapour pressure: Milazzo (1944)

Boiling point: 130°40 $\frac{dt}{dp}$ *(10 mm):* 0°48 B.E. (1934) and Lecat (passim)

Freezing point: −103°0 B.E. (1934)

Density

t°	d		t°	d	
0	1.64833	B.E. (1934)	20	1.6157	Vogel (1943)
15	1.62366	„	41.7	1.5815	„
30	1.59890	„	61.5	1.5492	„
			85.8	1.5090	„

Viscosity			*Surface tension*		
t°	$\eta \cdot 10^5$		t°	γ	
15	918	B.E. (1934)	15	29.78	B.E. (1934)
30	777	„	20	29.15	„
			30	27.90	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.49797	1.49850	1.50258	1.50277	1.51068	1.51266	—	B.E. (1934)
$\frac{dn}{dt}$	0.00052	53	54	54	55	55	—	„
20	—	1.49589	1.49984	—	—	1.50978	1.51769	Vogel (1943)

Iso-BUTYL IODIDE $(CH_3)_2CH—CH_2I$

Constants: B.E. (1934)

Boiling point / *Freezing point*

120°8	$\frac{dt}{dp}$ *(10 mm)*; 0°49 Lecat (passim)	−93°5	B.E. (1934)
121°00	„ 0°48 B.E. (1934)		

Density

t°	d	
0	1.63682	
15	1.61176	
30	1.58693	

Viscosity

t°	$\eta \cdot 10^5$	
15	945	
30	777	

Surface tension

t°	γ	
15	28.52	
20	27.97	
30	27.04	

Refractive index

t°	He r.	Hα	He y.	He v.	Hβ
15	1.49429	1.49483	1.49897	1.50698	1.50888
$\frac{dn}{dt}$	0.00049	49	49	49	50

Sec-BUTYL IODIDE $CH_3—CHI—C_2H_5$

Constants: B.E. (1934)

Boiling point: 120°00 $\frac{dt}{dp}$ *(10 mm):* 0°48 B.E. (1934) and LECAT (passim)

Freezing point: –104°0 B.E. (1934)

Density *Viscosity* *Surface tension*

t°	d		t°	$\eta \cdot 10^5$		t°	γ	
0	1.63055		15	885		15	28.60	
15	1.60584		30	725		20	28.34	
30	1.58099					30	27.85	

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.49770	1.49846	1.50265	1.50269	1.51104	1.51314	1.51960	1.52200
$\frac{dn}{dt}$	0.00050	50	51	51	52	52	—	—

VOGEL (1943) has studied a series of monochloro-, monobromo-, and monoiodo derivatives from C_4 to C_{12}. His constants can not be retained, because they do not agree with those given by most of the other authors.

E. HALOGENATED DERIVATIVES OF THE HIGHER HOMOLOGOUS PARAFFINS

n-AMYL FLUORIDE $C_4H_9—CH_2F$

Constants: SWARTS (1931)

Boiling point: 62°8 SWARTS (1931)

Density

t°	d		t°	d	
10.5	0.7960	Swarts (1931)	20	0.7905	Desreux (1935)
26	0.7880	„			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
20	372.0	Swarts (1931)	50	277.5	Swarts (1931)
30	335	„	60	252.5	„
40	303.5	„			

Surface tension: 20° 20.06 Desreux (1935)

Refractive index: 26° Hα: 1.35622 Hβ: 1.36183 Hγ: 1.36533 Swarts (1931)

The other halogenated derivatives of *n*-amylalcohol have not been studied with accuracy.

Iso-AMYL BROMIDE $(CH_3)_2CH{-}(CH_2)_2Br$

Constants: Timmermans and Hennaut-Roland (1929)

Boiling point

120°6	Grimm and Patrick (1923)
120°65	$\frac{dt}{dp}$ *(10 mm)*; 0°40 Timmermans and Hennaut-Roland (1929) and Lecat (passim)

Freezing point: − 111°9

Density			*Viscosity*			*Surface tension*		
t°	d		t°	$\eta \cdot 10^5$		t°	γ	
0	1.22912		15	792		15	26.40	
15	1.20950		30	652		20	25.86	
30	1.18989					30	24.79	

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.43996	1.44067	1.44332	1.44337	1.44828	1.44956	1.45351	1.45531
$\frac{dn}{dt}$	—	—	0.00049	50	—	49	—	51

Dielectric constant: 18° 6.1 GRIMM and PATRICK (1923)

2-FLUORO-, 2-CHLORO-, 2-BROMO- and 2-IODOPENTANES: CH_3—CHR—$(CH_2)_2$—CH_3
(R = F —Cl—Br—I)

Saturated vapour pressure, density, refractive index and *specific rotatory power;* BRAUNS, 1943.

UNDECA and PERFLUORO *n*-and *iso*-PENTANE $C_5F_{11}H$ and C_5F_{12}
Refractive index and *surface tension:* ROHRBACK and CADY (1949).

PENTAMETHYLENE DIBROMIDE CH_2Br—$(CH_2)_3$—CH_2Br

SERWY (1933) and JOHNSON (1933) studied the constants of this product, but their results do not agree.

n-HEXYL FLUORIDE
C_5H_{11}—CH_2F

Constants: DESREUX (1935)

Boiling point: 93°37

sec.-HEXYL FLUORIDE
or 2-FLUOROHEXANE
CH_3—CHF—C_4H_9

86°25

Density

t°	d	t°	d
0	0.8200	0	0.8185
15	0.8052	20	0.7916
20	0.8002		

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$
20	487.5	40	389.4	20	435.1
30	434.5	60	319.2		

Surface tension:	20° 21.83	—
Refractive index:	20°	20°39
Hα	1.3730	1.3677
D	1.3748	1.3693
Hβ	1.3791	1.3736
Hγ	1.3826	1.3771

n-HEPTYL FLUORIDE $C_6H_{13}—CH_2F$

Constants

Boiling point: 119°7

Melting point: −73°0

Density: 21° 0.80290 SWARTS (1919–21)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
20	626	SWARTS (1931)	50	441	SWARTS (1931)
30.04	553	,,	61	396	,,
40.1	491.0	,,			

Surface tension: 20° 23.20 DESREUX (1935)

Refractive index

t°	Hα	D	Hβ	Hγ	
21	1.38358	1.38550	1.38993	1.39358	SWARTS (1921–23)

n-HEPTYL PERFLUORIDE C_7F_{16}

Critical constants, saturated vapour pressure, boiling point, density, surface tension and *refractive index:* FOWLER, HAMILTON JR., KASPER, WEBER, BURFORD and ANDERSON (1947).

Refractive index and *surface tension:* ROHRBACK and CADY (1949).

n-HEPTYL CHLORIDES and *n*-HEPTYL BROMIDES

$CH_3—(CH_2)_5—CH_2Cl$; $CH_3—CHCl—(CH_2)_4—CH_3$; $C_2H_5—CHCl—(CH_2)_3—CH_3$;
$CH_3—(CH_2)_2—CHCl—(CH_2)_2—CH_3$; $CH_3—CHBr—(CH_2)_4—CH_3$;
$C_2H_5—CHBr—(CH_2)_3—CH_3$; $CH_3—(CH_2)_2—CHBr—(CH_2)_2—CH_3$

Melting point, density, refractive index and *dielectric constant;* SHERILL (1930) and ERRERA and SHERRILL (1930).

n-HEPTYL BROMIDE

$C_6H_{13}—CH_2Br$

n-HEPTYL IODIDE

$C_6H_{13}—CH_2I$

Constants: DEFFET (1931)

	n-Heptyl bromide	*n*-Heptyl iodide
Boiling point:	180°0	203°95
Melting point:	—58°1	—48°2

Density

t°	d		t°	d	
0	1.16134	DEFFET (1931)	0	1.40339	DEFFET (1931)
15	1.14526	„	15	1.38509	„
30	0.12909	„	30	1.36677	„

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	1432	DEFFET (1931)	15	1936	DEFFET (1931)
30	1117	„	30	1498	„

Surface tension

t°	γ		t°	γ	
15	29.00	DEFFET (1931)	15	30.88	HENNAUT-ROLAND and LEK (1931)
20	28.56	„	20	30.38	
30	27.50	„	30	29.53	„

Refractive index

t°	15	$\frac{dn}{dt}$	15	$\frac{dn}{dt}$	
He r.	1.44952	0.00043	1.48887	0.00045	DEFFET (1931)
Hα	1.44982	42	1.48924	45	„
He y.	1.45260	43	1.49297	46	„
He g.	1.45774	43	1.49998	46	„
Hβ	1.45894	43	1.50151	47	„
He v.	1.46248	44	1.50647	49	„
Hγ	1.46397	44	1.50812	—	„

	n-OCTYL FLUORIDE n-C_7H_{15}—CH_2F		n-OCTYL BROMIDE n-C_7H_{15}—CH_2Br		n-OCTYL IODIDE n-C_7H_{15}—CH_2I	
Constants	SWARTS (1919–23)		DEFFET (1931)		DEFFET (1931)	
Boiling point	142°8		201°5		225°55	
$\frac{dt}{dp}$ *(10 mm)*	—		0°55		0°60	
	—		—		225°5 DOBRINER (1888)	
Melting point	—		−55°0		−45°7	
Density	t°	d	t°	d	t°	d
	14.1	0.8120	0	1.13312	0	1.35312
	21	0.80361	15	1.11795	15	1.33568
			30	1.10269	30	1.31820
Viscosity			t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$
	—		15	1791	15	2408
			30	1382	30	1796
Surface tension			t°	γ		
	—		15	29.54	—	
			20	28.89		
			30	27.67		
			HENNAUT-ROLAND and LEK (1931)			
Refractive index t°	14°1		15°	$\frac{dn}{dt}$	15°	$\frac{dn}{dt}$
Her.	—		1.45173	0.00041	1.48681	0.00043
Hα	1.39520		1.45216	41	1.48729	43
D	1.39703		—	—	—	—
He y.	—		1.45489	41	1.49084	43
He g.	—		1.46002	41	1.49746	44
Hβ	1.40175		1.46126	41	1.49913	45
He v.	—		1.46487	41	1.50397	46
Hγ	1.40565		1.46640	41	1.50608	—

2-CHLORO-2,3,3-TRIMETHYLPENTANE CH_3-$CCl(CH_3)$-$C(CH_3)_2$-CH_2-CH_3

Constants: HOWARD, MEARS, FOOKSON, POMERANTZ and BROOKS (1947)

Freezing point	+10°6	*Refractive index*	$n_D^{20°}$ 1.4457
Density:	20° 0.9105		$n_D^{25°}$ 1.4436
	25° 0.9065		$\frac{dn}{dt}$ 0.00042

TRIALKYLCHLOROMETHANES: *Density* and *surface tension:* SMART and QUAYLE (1945)

F. HALOGENATED DERIVATIVES OF UNSATURATED ALIPHATIC HYDROCARBONS

VINYL CHLORIDE or MONOCHLOROETHYLENE $CH_2{=}CHCl$

Saturated vapour pressure: Roslovska and Temkin (1946)

t°	p atm.	t°	p atm.	t°	p atm.
10	2.51	40	5.76	70	11.23
20	3.39	50	7.24		
30	4.60	60	9.12		

VINYL BROMIDE or MONOBROMOETHYLENE $CH_2{=}CHBr$

Constants

Saturated vapour pressure: Mehl (1934)

t°	p mm	t°	p mm	t°	p mm
−66	9.5	−21.0	150.2	7.8	560.9
−53.5	23.2	−10.5	248.9	10.0	610.5
−43.0	44.1	0.0	402.1	11.9	657.4
−29.5	97.0	5.2	501.0		

Boiling point

15°60	Mehl (1934)
15°8	Lecat (passim)
15°80	Timmermans (1913)

Freezing point

−137°8	Timmermans (passim)

VINYLIDENE CHLORIDE or 1,1-DICHLOROETHYLENE $CH_2{=}CCl_2$

Saturated vapour pressure: Roslovska and Temkin (1946)

t°	p atm.	t°	p atm.	t°	p atm.	
10	0.39	40	1.21	70	3.09	(The authors give somewhat higher values for another sample)
20	0.59	50	1.69	80	4.07	
30	0.85	60	2.30			

1,2-DICHLOROETHYLENES $(CHCl)_2$

Constants

Saturated vapour pressure

Trans t°	*Trans* p mm	*Cis* t°	*Cis* p mm	
−38.19	10.4	−33.00	9.3	Ketelaar, Van Velden and Zalm (1947)
−30.14	20.4	−12.35	32.3	
−28.30	22.5	− 6.23	44.9	„
−19.19	41.2	+ 0.76	64.7	„
−15.12	50.5	30.06	250.4	„
− 7.29	75.7	77.40	1286.4	„
+ 0.52	113.0	99.03	2304.7	„
16.91	237.4			„
39.52	571.9			„
56.12	1000.5			„
84.84	2284.4			
				(other temperatures by authors)

Boiling point

Trans	*Cis*
47°66 Eftring (1938)	60°25 Chavanne (1912)
47°7 Ketelaar, Van Velden and Zalm (1947)	60°27 Eftring (1938)
	60°5 Ketelaar, Van Velden and Zalm (1947)

Freezing point

Trans	*Cis*
—	−80°5 Timmermans

Density

t°	*Trans*	*Cis*	
15°	—	1.2913	Chavanne (1912)
20°	1.2546	1.2818	Eftring (1938)
15°	1.2631	1.2917	Ketelaar, De Vries, Van Velden and Kooij (1947)
20°	1.2547	1.2837	„

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
−50	1005	−10	560	−65	1538	−15	690	Ketelaar, De Vries, Van Velden and Kooij (1947)
−45	925	− 5	526	−60	1393	−10	647	
−40	847	0	498	−55	1271	− 5	609	
−35	783	+ 5	471	−50	1156	0	577	
−30	729	10	447	−45	1057	+ 5	546	„
−25	682	15	423	−40	973	10	516	„
−20	637	20	404	−35	904	15	490	„
−15	597			−30	843	20	467	„
				−25	791	25	444	„
				−20	738			„

1,2-DICHLOROETHYLENES (continued)

		Trans	*Cis*	
Surface tension	20°	25	28	Ketelaar, De Vries, Van Velden and Kooij (1947)

Refractive index

t°	Hα	D	Hβ	Hα	D	Hβ	
10.4	1.44849	—	1.46002	1.45139	—	—	Chavanne(1912)
15	1.44556	1.44903	1.45715	1.44868	1.45189	1.45981	,,
$\frac{dn}{dt}$	0.00063	—	0.00062	0.00059	—	—	,,
20	—	1.4462	—	—	1.4490	—	Eftring (1938)

		Trans	*Cis*	
Dielectric constant	25°	2.145	9.31	Ketelaar, Van Velden and Zalm (1947)
Heat of combustion (c_v) cal 15°/g	20°	2682.5	2688.5	Eftring (1938)

1,2-DIIODOETHYLENE *(Trans)* $(CHI)_2$

Prepared by the method of Chavanne and Vos (1914), which consists in passing anhydrous acetylene over iodine. The sample has a melting point of 72°.

Saturated vapour pressure: Broadway and Fraser (1933).

TETRACHLOROETHYLENE C_2Cl_4

Stabilisation by thymol (Bailey, 1939)

Constants: B.E. (1930)

Boiling point: 121°0 $\frac{dt}{dp}$ *(10 mm):* 0°50 Lecat (passim)

121°20 ,, 0°50 B.E. (1930)

Freezing point: −22°35 B.E. (1930)

Density

t°	d	
0 15 30	1.65582 1.63109 1.60640	

Viscosity

t°	$\eta \cdot 10^5$	
15 30	932 798	

Surface tension

t°	γ
15	32.86
20	32.32
30	31.27

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.50289	1.50348	1.50759	1.51537	1.51723	1.52334
$\frac{dn}{dt}$	0.00051	53	53	53	53	52

TRIFLUOROMONOCHLOROETHYLENE C_2F_3Cl

Constants

Critical constants

t° cr.	p cr. atm.	
107.0	39.0	Booth and Swinehart (1935)

Saturated vapour pressure

t°	p mm	t°	p mm	
−78.56	45.2	−26.46	815.0	Booth, Burchfield, Bixby and Mac Kelvey (1933)
−33.56	593.4	−25.36	853.7	
−28.46	742.1	−23.46	920.7	„
−27.76	767.3			„

t°	p atm.	t°	p atm.	
21.9	5.7	81.2	24.6	BOOTH and SWINEHART (1935)
33.8	8.0	91.3	28.2	,,
40.3	9.9	100.8	35.1	,,
60.3	15.5	101.7	35.4	,,
72.3	19.1	104.3	37.1	,,

Boiling point: —27°9 BOOTH, BURCHFIELD, BIXBY and MAC KELVEY (1933)

Freezing point: –157°5 ,,

ALLYL CHLORIDE $CH_3CH{=}CHCl$

Constants: B.E. (1932)

Boiling point: 45°10 $\frac{dt}{dp}$ *(10 mm):* 0°.42 B.E. (1932)

45°15 LECAT (passim)

Freezing point: –134°5 B.E. (1932)

Density *Viscosity* *Surface tension*

t°	d		t°	$\eta \cdot 10^5$		t°	γ
0	0.96374		15	347		15	28.85
15	0.94419		30	300		20	23.06
30	0.92454					30	21.83

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.41534	1.41582	1.41887	1.42462	1.42597	1.43056	1.43225
$\frac{dn}{dt}$	0.00068	69	69	72	74	74	75

1,3-DICHLOROPROPENES: *boiling point, density* and *refractive index:* HATCH and PERRY Jr. (1949).

G. HALOGENATED DERIVATIVES OF THE AROMATIC SERIES

Derivatives of Benzene

FLUOROBENZENE C_6H_5F

Constants: B.E. (1935)

Boiling point: 84°75 Morre and Hobbs (1949)
84°85 $\frac{dt}{dp}$ *(10 mm):* 0°40 B.E. (1935)
84°9 Lecat (passim)

Freezing point: −41°9 B.E. (1935)

Density

t°	d		t°	d	
0	1.04863	B.E. (1935)	30	1.01314	B.E. (1935)
15	1.03091	„	20	1.0252	Desreux (1935)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	620	B.E. (1935)	19.95	582.2	Swarts (1931)
30	517	„	30	516.4	„
			39.95	460	„
			50	414.7	„
			60.04	375	„

Surface tension

t°	γ		t°	γ	
15	28.41	B.E. (1935)	20	27.71	Desreux (1935)
20	27.78	„			
30	26.47	„			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.
15	1.46338	1.46412	1.46837	1.46853	1.47653	1.47865	1.48522
$\frac{dn}{dt}$	0.00049	49	—	50	50	50	50

Heat constants: Stull (1937)

Specific heat

t°	c_p	t°	c_p	t°	c_p
C. −183.16	0.1171	−103.16	0.2087	−23.16	0.3477
−173.16	0.1275	− 93.16	0.2216	−13.16	0.3533
−163.16	0.1385	− 83.16	0.2348	− 3.16	0.3578
−153.16	0.1499	− 73.16	0.2477	+ 6.84	0.3608
−143.16	0.1608	− 63.16	0.2609	+16.84	0.3548
−133.16	0.1730	− 53.16	0.2745	+26.84	0.3652
−123.16	0.1842	− 43.16	0.2878	+36.84	0.3676
−113.16	0.1971	L. − 33.16	0.3402	+46.84	0.3735

Heat of melting	25.885 cal 15°/g	

CHLOROBENZENE C_6H_5Cl

Constants: B.E. (1926). — **Polyphasic equilibria**

Densities of the liquid and of the saturated vapour

t°	L.	t°	L.	V.	
0	1.12786	150	0.9599	—	Young (1910)
10	1.1171	160	0.9480	—	„
20	1.1062	170	0.9354	0.008375	„
30	1.0954	180	0.9224	0.01023	„
40	1.0846	190	0.9091	0.01247	„
50	1.0742	200	0.8955	0.01506	„
60	1.0636	210	0.8815	0.01808	„
70	1.0526	220	0.8672	0.02145	„
80	1.0419	230	0.8518	0.02544	„
90	1.0305	240	0.8356	0.03000	„
100	1.0189	250	0.8196	0.03540	„
110	1.0079	260	0.8016	0.04172	„
120	0.9960	270	0.7834	0.04921	„
130	0.9836	329.2	0.6411	—	„
140	0.9723	358.8	0.4400	—	„

Rectilinear diameter: $0.5640 - 5337 \cdot 10^{-7}\, t° - 509 \cdot 10^{-10}\, t°^2$ Young (1910): Ramsay and Young (1887)

Critical constants

t° cr.	p cr. mm	d cr.	
359.2	33926	0.3654	Young (1909–10)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−15.1	0.913	−30.1	0.267	−35.1	0.176	Mündel (1913)
−25.1	0.410					„
70	99.3					Martin and Collie (1932)
0	2.52	100	292.75	200	3521	Young (1910)
10	4.86	110	402.55	210	4229	„
20	8.76	120	542.80	220	5056	„
30	15.45	130	718.95	230	5989	„
40	26.00	140	939.4	240	7080	„
50	41.98	150	1206	250	8270	„
60	65.54	160	1534	260	9647	„
70	97.90	170	1920	270	11188	„
80	144.75	180	2370	329.2	23935	„
90	208.35	190	2902	358.8	33824	„
99.231	289.1	131.687	760.00	165.309	1741.0	Zmaczynski (1930)
105.629	355.1	138.318	906.1	172.173	2026.3	„
112.074	433.9	144.996	1074.6	179.084	2347.4	„
118.565	525.76	151.720	1268.1			„
125.103	633.90	158.491	1489.2			„

Boiling point

131°687	$\frac{dt}{dp}$ *(10 mm):* 0°488 Zmaczynski (1930)	132°00	$\frac{dt}{dp}$ *(10 mm):* 0°49 B.E. (1926) (Young's value (1902) taken as standard).
131°75	„ 0°51 Lecat (passim)		

Freezing point

−45°1	B.E. (1926)	−45°21	Stull (1937)

Constants of state

Density

t°	d		t°	d	
0	1.12792	B.E. (1926)	0	1.12795	Young (1910)
15	1.11172	„	10	1.1171	„
30	1.09550	„	20	1.1062	„
			30	1.09550	„
0	1.12792	Biron (1910)			
20	1.10643	„			
40	1.0848	„			
9.7	1.1172	Meyer and Mylius (1920)	80.4	1.0415	Meyer and Mylius (1920)
10	1.1169	„	83.3	1.0385	„
17.6	1.1090	„	88.1	1.0330	„
20.1	1.1060	„	96.2	1.0235	„
25.1	1.1010	„	102.2	1.0170	„
30.2	1.0950	„	107.8	1.0100	„
35.0	1.0901	„	113.1	1.0040	„
55	1.0690	„	119.6	0.9962	„
60	1.0640	„	123.6	0.9915	„
63.7	1.0600	„			
15	1.11150	Perkin (1896)	−45.0	1.17713	Timmermans (1912)
20	1.1063	„	−35.3	1.16630	„
30	1.0957	„	−30.6	1.16103	„
45	1.0794	„	−22.95	1.15253	„
50	1.0740	„	−13.1	1.14201	„
			− 6.2	1.13452	„
24.12	1.10215	Patterson and Mac Donald (1908)	0	1.12795	„
38.53	1.08650	„			
28	1.0978	Velasco (1927)	72.1	1.0505	Velasco (1927)
30.1	1.0955	„	75.1	1.0470	„
46.1	1.0783	„	80.8	1.0404	„
47.9	1.0763	„	94.8	1.0251	„
64.1	1.0587	„	108.6	1.0100	„
66.4	1.0562	„			
0	1.12780	Tyrer (1914)	25	1.1010	Coates and Coates (1944)
20	1.1061	Bramley (1916)			
20	1.10617	Zmaczynski (1930)	25	1.10110	Gibson and Loeffler (1939)
25	1.10085	Le Fevre and Le Fevre (1936)			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
20.1	803	Meyer and Mylius (1920)	15	844	B.E. (1926)
25.1	755	,,	30	711	,,
30.2	710	,,	20	794	Dezelic (1937)
35.0	678	,,	25	758	Dunstan, Hilditch and Thole (1913)
35.2	672	,,			

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
12.5	876	70.0	472	130.0	292	180.0	209	Titani (1927)
20.0	799	80.0	431	131.7	287	190.0	196	,,
30.0	715	90.0	397	140.0	273	200.0	186	,,
40.0	631	100.0	367	150.0	257	210.0	173	,,
50.0	571	110.0	339	160.0	239	220.0	162	,,
60.0	512	120.0	313	170.0	222	230.0	155	,,
						240.0	144	,,

Surface tension

t°	γ	
15	33.86	Hennaut-Roland and Lek (1931)
20	33.28	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.52172	1.52242	1.52748	1.52749	1.53725	1.53965	1.54735	B.E. (1926)
$\frac{dn}{dt}$	0.00054	54	54	55	55	55	55	,,
8.9	—	1.52579	1.53058	—	—	—	—	Hinstedt and Wertheimer (1922)
20	—	—	1.52460	—	—	—	—	Davies (1936)
25	—	1.51697	—	—	—	—	—	Martin and Collie (1932)
5.5	1.52678	—	—	1.53251	1.54244	—	1.55254	Kalff (1924)
33.75	1.51166	—	—	1.51723	1.52685	—	1.53668	,,
64.0	1.49535	—	—	1.50074	1.51001	—	1.51953	,,
90.86	1.48045	—	—	1.48566	1.49467	—	1.50388	,,
107.6	1.47136	—	—	1.47643	1.48534	—	1.49427	,,

Kalff also gives values of the refractive index for other wavelengths. His compound was pure but the densities are affected by a systematic error.

Dielectric constant

t°	ε		t°	ε	
21	5.670	LE FEVRE (1938)	70	4.886	LE FEVRE (1938)
40	5.372	,,	80	4.768	,,
48	5.227	,,	96.2	4.521	,,
20	5.6493	PIETTE (1947)	106	4.435	,,
			115	4.314	,,
			124	4.214	,,
			131	4.144	,,

Heat constants

Specific heat: STULL (1937)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
−183.16	0.1067	−123.16	0.1684	−63.16	0.2201	− 3.16	0.3152
−173.16	0.1179	−113.16	0.1769	−53.16	0.2324	+ 6.84	0.3167
−163.16	0.1298	−103.16	0.1843	−43.16	0.2916	16.84	0.3179
−153.16	0.1394	− 93.16	0.1915	−33.16	0.3022	26.84	0.3191
−143.16	0.1495	− 83.16	0.1993	−23.16	0.3091	36.84	0.3216
−133.16	0.1590	− 73.16	0.2087	−13.16	0.3130	46.84	0.3269

Heat of melting	20.491 cal 15°/g	STULL (1937)

BROMOBENZENE C_6H_5Br

Constants: B.E. (1926). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
397	33912	0.4853	YOUNG (1909–10)

Densities of the liquid and of the saturated vapour

t°	L.	t°	L.	V.	
0	1.52182	140	1.3293	—	Young (1909–10)
10	1.5083	150	1.3146	0.004125	„
20	1.4948	160	1.2994	0.005241	„
30	1.4815	170	1.2847	0.006562	„
40	1.4682	180	1.2697	0.008117	„
50	1.4546	190	1.2534	0.009950	„
60	1.4411	200	1.2385	0.01209	„
70	1.4272	210	1.2210	0.01458	„
80	1.4142	220	1.2037	0.01745	„
90	1.4006	230	1.1876	0.02079	„
100	1.3864	240	1.1689	0.02482	„
110	1.3729	250	1.1510	0.02927	„
120	1.3583	260	1.1310	0.03427	„
130	1.3439	270	1.1099	0.04016	„

Rectilinear diameter: $0.7609 - 6655 \cdot 10^{-7}\, t° - 725 \cdot 10^{-10}\, t°^2$ Young (1909–1910)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
120	274.9	130	372.65	140	495.8	150	649.05	Ramsay and Young
121	283.65	131	383.85	141	509.7	151	666.25	„ (1887)
122	292.6	132	395.1	142	523.9	151	683.8	„
123	301.75	133	406.7	143	538.4	153	701.65	„
124	311.15	134	418.6	144	553.2	154	719.95	„
125	320.8	135	430.75	145	568.35	155	738.55	„
126	330.7	136	443.2	146	583.85	156	757.55	„
127	340.8	137	455.9	147	599.65	157	776.95	„
128	351.15	138	468.9	148	615.75			„
129	361.8	139	482.2	149	632.25			„

t°	p mm	t°	p mm	t°	p mm	
121.588	289.1	148.944	633.90	184.261	1489.2	Zmaczynski (1930)
128.352	355.1	162.921	906.1	191.474	1741.0	„
135.166	433.6	169.985	1074.6	198.737	2026.3	„
142.030	525.76	177.098	1268.1	206.049	2347.4	„

Boiling point

155°908	$\frac{dt}{dp}$ (10 *mm*):	0°5165	Zmaczynski (1930)
156°1	„	0°53	Lecat (passim)
156°15	„	0°53	Timmermans (1912) and B.E. (1926)
156°16	„	0°49	Young (1902)
156°2			Richards and Barry (1915)
156°3			Rolla (1909–10)

The boiling point given by Young: 156°0, was calculated by means of a formula which does not hold at this temperature. The observed boiling point was 156°16.

Freezing point

−30°6	B.E. (1926) and Deffet (1940)	−30°67	Stull (1937)

Melting curve

t°	p kg/cm^2	t°	p kg/cm^2	
−30.6	1	−18.0	693	Deffet (1940)
−23.2	416	−13.0	914	„

Density

t°	d		t°	d	
0	1.52204	B.E. (1926)	0.1	1.5220	Meyer and Mylius (1920)
15	1.50170	„	5.9	1.51410	„
30	1.48150	„	16.6	1.4998	„
0	1.52182	Young (1910)	18.2	1.4975	„
10	1.50830	„	21.9	1.4925	„
20	1.4948	„	28.3	1.4841	„
30	1.4815	„	33.1	1.4776	„
0	1.52193	Timmermans (1912)	43.6	1.4630	„
20	1.49519	Zmaczynski (1930)	49.5	1.4553	„
20	1.4952	Dezelic (1937)	61.4	1.4392	„
25	1.48791	Bugarski (1911)	71.2	1.4257	„

Viscosity

t°	$\eta \cdot 10^5$	
15	1196	B.E. (1926)
30	985	„
20	1124	Dezelic (1937)

Surface tension

t°	γ	
15	36.93	Hennaut-Roland and
20	36.34	„ Lek (1931)
30	35.09	„

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.55700	1.56252	1.57636	1.58837	B.E. (1932)
$\frac{dn}{dt}$	0.00048	49	50	52	
20	—	1.5602	—	—	FISCHER and REICHEL (1943)

Heat constants

Specific heat: STULL (1937)

t°	c_p	t°	c_p	t°	c_p
C. −183.16	0.08360	−103.16	0.1314	L. −23.16	0.2229
−173.16	0.08908	− 93.16	0.1381	−13.16	0.2289
−163.16	0.09430	− 83.16	0.1451	− 3.16	0.2329
−153.16	0.1000	− 73.16	0.1519	+ 6.84	0.2350
−143.16	0.1059	− 63.16	0.1596	+16.84	0.2359
−133.16	0.1121	− 53.16	0.1674	+26.84	0.2368
−123.16	0.1187	− 43.16	0.1759	+36.84	0.2384
−113.16	0.1249	− 33.16	0.1845	+46.84	0.2420

Heat of melting	16.186 cal 15°/g	STULL (1937)

IODOBENZENE C_6H_5I

This compound is prepared by the action of nitric acid and iodine on benzene. YOUNG's sample was not pure.

Constants: B.E. (1932). — **Polyphasic equilibria**

Boiling point

188°33	ROLLA (1909)		
188°36	HOLLEMAN (1904)	188°45	$\frac{dt}{dp}$ *(10 mm):* 0°56 LECAT (passim)
188°45	$\frac{dt}{dp}$ *(10 mm):* 0°57 B.E. (1932)	188°60	FEITLER (1889)

Freezing point

−31°27	STULL (1937)	−31°35	B.E. (1932)

Constants of state

Density

t°	d		t°	d	
0	1.86102	B.E. (1932)	24.8	1.82363	Patterson and Mac Donald (1908)
15	1.83829	„	31.25	1.8138	„
30	1.81548	„	25	1.8230	Jaeger (1917)
4	1.8551	Perkin (1896)	60	1.7699	Perkin (1896)
10	1.8458	„	65	1.7622	„
15	1.8384	„	70	1.7544	„
25	1.8230	„	75	1.7468	„
35	1.8077	„	80	1.7391	„
40	1.7996	„	85	1.7319	„
45	1.7928	„	90	1.7238	„
50	1.7854	„	95	1.7165	„
55	1.7777	„	100	1.7092	„

Viscosity

t°	$\eta \cdot 10^5$	
15	1740	B.E. (1932)
30	1417	„

Surface tension

t°	γ		t°	γ	
14	41.21	Sugden (1924)	20	41.45	Bodson (1937)
50	36.93	„	40	38.69	„
98	31.62	„	60	35.94	„
124	28.80	„	70	34.57	„
146	26.27	„	80	33.19	„
169	23.91	„			
180	22.64	„			

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.61469	1.61559	1.62298	1.63735	1.64098	1.65221
$\frac{dn}{dt}$	0.00054	53	55	58	58	58

Specific magnetic rotatory power

t°	μ		t°	μ	
10.4	3.1176	Perkin (1896)	54.9	2.9910	Perkin (1896)
15.0	3.1024	„	85.1	2.9368	„

Heat constants: Stull (1937)

Specific heat

t°	c_p	t°	c_p	t°	c_p
C. −183.16	0.06330	−103.16	0.1007	L. −23.16	0.1815
−173.16	0.06825	− 93.16	0.1055	−13.16	0.1830
−163.16	0.07306	− 83.16	0.1108	− 3.16	0.1840
−153.16	0.07776	− 73.16	0.1160	+ 6.84	0.1846
−143.16	0.08262	− 63.16	0.1216	+16.84	0.1854
−133.16	0.08733	− 53.16	0.1274	+26.84	0.1861
−123.16	0.09174	− 43.16	0.1333	+36.84	0.1863
−113.16	0.09414	− 33.16	0.1392	+46.84	0.1884

Heat of melting	11.426 cal 15°/g	

DIFLUOROBENZENES

	Meta m-$C_6H_4F_2$			*Para* p-$C_6H_4F_2$		
Constants						
Boiling point		—			88°82	Swarts (1913–19)
Melting point		—			−23°7	„
Density:		—		18°5	1.1725	Swarts (1913–19)
	16°2	1.16400	Swarts (1923)	18°9	1.1722	Swarts (1923)
	20°	1.1571	Desreux (1935)	20°	1.17006	Desreux (1935)
Viscosity: $\eta \cdot 10^5$	20°	574.3	Swarts (1931)	20°	639	Swarts (1931)
	30°	512.2	„	30°	568	„
	40°	461	„	40°	507.5	„
	50°	415.6	„	50°	456.5	„
	60°	378.6	„	60°	413.5	„
Surface tension	20°	25.93	Desreux (1935)	20°	27.05	Desreux (1935)
Refractive index						
Hα	16°	1.43509	Swarts (1923)	18°9	1.43846	Swarts (1913)
D		1.43921	„		1.44219	„
Hβ		1.44766	„		1.45157	„
Hγ		1.45556	„		1.45957	„

Ortho-DICHLOROBENZENE $o\text{-}C_6H_4Cl_2$

Constants

Boiling point

179°5	LECAT (passim)	180°35	$\frac{dt}{dp}$ *(10 mm):* 0°57 CARSWELL (1928)

Freezing point

−16°7	CARSWELL (1928)	−17°2	KALFF (1924)

Density

t°	d	
15	1.3100	CARSWELL (1928)
20	1.3064	,,

Refractive index

t°	He r.	D	He y.	He g.	He v.	
12.8	1.54936	—	1.55526	1.56560	1.57614	KALFF (1924)
32.8	1.53962	—	1.54544	1.55553	1.56590	,,
$\frac{dn}{dt}$	0.00048	—	49	50	51	,,
22	—	1.5518	—	—	—	CARSWELL (1928)

Dielectric constant: 25°: 6.8281 LE FEVRE and LE FEVRE (1936)

Para-DICHLOROBENZENE $p\text{-}C_6H_4Cl_2$

Constants

Saturated vapour pressure

t°	p mm	
10	0.232	DARKIS, VERMILLON and GROSS (1940)
30	1.63	,,
50	8.435	,,

Boiling point

173°7	PERKIN (1896)	174°4	LECAT (passim)
173°8	KRUYT (1912)		

Freezing point

53°2	Hrynakowski and Szmyt (1938)	53°13	Cooper (1926–'27)
53°2	Morris and Cook (1935)	53°08	Campbell and Prodan (1948)
53°2	Martin and Georges (1933)	53°0	Beck and Ebbinghaus (1906)
53°2	Kalff (1924)	53°0	Hrynakowski and Smoczkicwiczowa (1937)
53°2	Perkin (1896)		
53°15	Deffet (1938)	53°0	Kruyt (1912)

Melting curve: Deffet (1938–1940)

t°	p kg/cm²	t°	p kg/cm²
53.15	1	70.00	510
55.00	45	75.00	660
60.00	196	80.00	812
65.00	353	85.00	956

Density

t°	d		t°	d	
55	1.2495	Perkin (1896)	75	1.2264	Perkin (1896)
60	1.2437	,,	80	1.2207	,,
65	1.2378	,,	90	1.2112	,,
70	1.2321	,,			

Surface tension

t°	γ		t°	γ	
68	30.69	Sugden (1924)	150	22.05	Sugden (1924)
96	27.58	,,	166	20.44	,,
117	25.44	,,	170	19.82	,,
139	22.92	,,			

Refractive index

t°	He r.	He y.	He g.	He v.	
55.2	1.52397	1.52988	1.53991	1.55017	Kalff (1924)
77.2	1.51307	1.51877	1.52859	1.53865	,,

Melting point, density and refractive index of *meta*-dichloro, 1,2,3-, 1,2,4-, 1,3,5-trichloro-, *ortho*-, *meta*- and *para*-tetrachloro- and pentachloro-benzene are given by Kalff (1924). The melting points and the refractive indexes seem good; the densities are affected by a systematic error.

Para-DIBROMOBENZENE $p\text{-}C_6H_4Br_2$

Constants

Boiling point		*Melting point*	
220°25	Lecat (passim)	87°30 87°3 87°2	Campbell and Prodan (1948) Deffet (1938) Kruyt (1912)

Melting curve: Deffet (1938–1940)

t°	p kg/cm²	t°	p kg/cm²
87.3	1	110.0	640
95.0	213	115.0	790
100.0	348	120.0	931

Viscosity: from 94°8 to 193°2 Golik and Ravikovitch (1949)

1,2,3; 1,2,4 and 1,3,5-TRICHLOROBENZENES and HEXACHLOROBENZENE

Saturated vapour pressure and *melting point:* Sears and Hopke (1949)

Derivatives of Toluene

FLUOROTOLUENES $C_6H_4F\text{—}CH_3$

Constants

		Ortho	*Meta*	*Para*	
Density		17°3 1.00142 Swarts (1923)	20° 0.9974 Desreux (1935)	—	
Viscosity: $\eta \cdot 10^5$	20°	679.5	608	621.5	Swarts (1931)
	30°	600.5	534	552.5	„
	40°	537.5	481	495	„
	50°	481	453.7	—	„
	60°	434	395.5	405	„
Surface tenstion		—	20° 27.97	—	Desreux (1935)
Refractive index		17°3			
	Hα	1.46705	—	—	Swarts (1923)
	D	1.47161			
	Hβ	1.48235			
	Hγ	1.49000			

PHENYLFLUOROFORM or BENZOTRIFLUORIDE $C_6H_5—CF_3$

Prepared by **Swarts** by the action of SbF_3 on $C_6H_5CCl_3$ and purified by fractional distillation.

Constants

Boiling point: 103°46 **Swarts** (1919)

Density

t°	d	
13.3	1.19040	**Swarts** (1923)
19.2	1.18857	„ (1919)
20	1.1886	**Desreux** (1935)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
19.8	574.0	**Swarts** (1931)	50	420.4	**Swarts** (1931)
30	512.0	„	60	387.3	„
40	462.4	„			

Surface tension: 20°: 23.39 **Desreux** (1935)

Refractive index

t°	Hα	D	Hβ	Hγ	
13.3	1.41180	1.41486	1.42287	1.42918	**Swarts** (1923)

BENZYL CHLORIDE $C_6H_5—CH_2Cl$

This substance is very unstable when hot and is oxidized by air with the loss of HCl.

Constants: B.E. (1935)

Saturated vapour pressure

t°	p mm		t°	p mm	
48.3	0	**Kahlbaum** (1884)	76.1	20	**Kahlbaum** (1884)
58.7	5	„	80.5	25	„
66.1	10	„	94.2	50	„
71.3	15	„	102.8	75	„

Boiling point / *Freezing point*

Boiling point		Freezing point	
179°0	**Kahlbaum** (1884)	−39°2	B.E. (1935)
179°3	**Lecat** (passim)		
179°35	**Timmermans** (1913)		

Density / *Viscosity* / *Surface tension*

t°	d	t°	$\eta \cdot 10^5$	t°	γ	
0	1.11875	15	1501	15	38.43	B.E. (1935)
15	1.10426	30	1175	20	37.80	”
30	1.08977			30	36.63	”
—	—	25	1280	—	—	**Dunstan, Hilditch** and **Thole** (1913)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.
15	1.53570	1.53638	(1.54124)	1.54150	1.55190	1.55407	1.56190
$\frac{dn}{dt}$	0.00048	48	—	49	49	49	50

PHENYLCHLOROFORM or BENZOTRICHLORIDE $C_6H_5—CCl_3$

Prepared by chlorination of toluene in the presence of 2 % of phosphorus trichloride, and purified by fractional distillation. Phenylchloroform is very unstable.

Constants

Boiling point / *Freezing point*

Boiling point		Freezing point	
220°64	**Swarts** (1923)	−4°75	**Swarts** (1923)
220°8	**Lecat** (passim)	−5°0	**Holleman** (1914)

Density / *Surface tension*

t°	d				
15	1.3775	**Swarts** (1923)	20°	38.03	**Desreux** (1935)
20	1.3723	**Desreux** (1935)			

Ortho-CHLOROTOLUENE $o\text{-}C_6H_4Cl\text{—}CH_3$

Constants: B.E. (1930)

Boiling point		*Freezing point*	
159°15	$\frac{dt}{dp}$ *(10 mm)*: 0°52	−36°5	
159°2	Lecat (passim)		

Density			*Viscosity*			*Surface tension*	
t°	d		t°	$\eta \cdot 10^5$		t°	γ
0	1.10180		15	1037		15	33.99
15	1.08729		30	887		20	33.44
30	3.07279					30	32.33

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.52254	1.52322	1.52827	1.53770	1.53997	1.54747	1.55051
$\frac{dn}{dt}$	0.00045	46	48	48	48	48	47

Bingham and Geddes (1934) measured the densities and viscosities of the three chloro- and bromo-toluenes at various temperatures. For *ortho*-chlorotoluene, these densities and those of B.E. do not agree; for *para*-bromotoluene, the densities are 6/10,000 lower than those of Perkin. We are not aware of any other comparison data.

Para-CHLOROTOLUENE $p\text{-}C_6H_4Cl\text{—}CH_3$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
40.3	5	59.6	20	77.7	50	Kahlbaum (1884)
48.9	10	63.7	25	84.9	75	”
54.2	15					”

Boiling point: 162°4 **Lecat** (passim)
162°50 **Feitler** (1889)

Viscosity

t°	$\eta \cdot 10^4$		t°	$\eta \cdot 10^4$	
10	103	**Bingham** and **Geddes**	60	56	**Bingham** and **Geddes**
20	89	„ (1934)	80	47	„ (1934)
30	78	„	100	40	„
40	70	„			

Surface tension

t°	γ		t°	γ	
25	32.24	**Sugden** (1924)	108	23.32	**Sugden** (1924)
30	29.22	„	120	22.11	„
64	27.96	„	151	19.11	„
79	26.17	„			

Ortho-BROMOTOLUENE $o\text{-}C_6H_4Br—CH_3$

Constants

Saturated vapour pressure

t°	p mm		t°	p mm	
44.4	0	**Kahlbaum** (1884)	75.2	20	**Kahlbaum** (1884)
55.4	5	„	79.6	25	„
63.4	10	„	95.7	50	„
69.8	15	„	104.4	75	„

Boiling point | *Freezing point*

181° 181°5	**Perkin** (1896) **Lecat** (passim)	−28°1	**Timmermans** (passim)

Viscosity

t°	$\eta \cdot 10^4$		t°	$\eta \cdot 10^4$	
0	221	BINGHAM and GEDDES	40	112	BINGHAM and GEDDES
10	181	„ (1934)	60	87	„ (1934)
20	151	„	80	71	„
30	129	„	100	59	„

Specific magnetic rotatory power: 16°7 2.3556 PERKIN (1896)

Para-BROMOTOLUENE p-$C_6H_4Br—CH_3$

Constants

Boiling point / *Melting point*

185°0	LECAT (passim)		26°7	VAN DER LAAN (1907)

Density

t°	d		t°	d	
35	1.3877	PERKIN (1896)	70	1.3441	PERKIN (1896)
40	1.3813	„	75	1.3338	„
45	1.3752	„	80	1.3316	„
50	1.3691	„	85	1.3241	„
55	1.3630	„	90	1.3190	„
60	1.3569	„	95	1.3128	„
65	1.3505	„	100	1.3076	„
30	1.3937	BINGHAM and GEDDES	80	1.3319	BINGHAM and GEDDES
40	1.3816	„ (1934)	100	1.3074	„ (1934)
60	1.3563	„			

Viscosity

t°	$\eta \cdot 10^4$		t°	$\eta \cdot 10^4$	
30	109.5	BINGHAM and GEDDES	60	76.8	BINGHAM and GEDDES
40	94.4	„ (1934)	100	53.1	„ (1934)

Dielectric constant: 28° 5.07 CAUWOOD and TURNER (1915)

Specific magnetic rotatory power: 39° 2.2084; 89° 2.1351 PERKIN (1896)

1,1-DI-*p*-CHLOROPHENYL-2,2,2-TRICHLOROETHANE $(C_6H_4Cl)_2CH—CCl_3$

Saturated vapour pressure KUHN and MASSINI (1949)

Derivatives of Naphthalene

α-BROMONAPHTHALENE $\alpha\text{-}C_{10}H_7Br$

Constants: B.E. (1937)

Boiling point

281°2	Lecat (passim)

Melting point

6°10	B.E. (1937) and Deffet (1940)
6°20	Jones and Lapworth (1914)

Melting curve

t°	p kg/cm²		t°	p kg/cm²	
6.10	1	Deffet (1940)	25.00	703	Deffet (1940)
16.00	370	,,	30.00	885	,,
20.00	518	,,			

Density

t°	d		t°	d	
0	1.50343	B.E. (1937)	20	1.4834	Jones and Lapworth
15	1.48834	,,	25	1.4785	,, (1914)
30	1.47317	,,			

Viscosity

t°	$\eta \cdot 10^5$	
15	5993	B.E. (1937)
30	4031	,,

Surface tension

t°	γ	
15	45.16	B.E. (1937)
20	44.59	,,
30	43.36	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.64993	(1.65120)	(1.66009)	1.66033	1.67893	(1.68385)	1.69926	—	B.E. (1937)
$\frac{dn}{dt}$	0.00043	—	—	0.00044	0.00044	—	0.00044	—	,,
(Hα, D, Hβ, are interpolated values)									
20	—	1.6494	1.6582	—	—	1.6819	—	1.7037	Jones and Lapworth (1914)

H. HALOGENATED DERIVATIVES OF THE CYCLOPARAFFINS

*Cyclo*PENTYL CHLORIDE C_5H_9Cl

Constants: La Bruyere (unp.)

Freezing point: −94°3

Density | *Viscosity* | *Surface tension*

t°	d	t°	$\eta \cdot 10^5$	t°	γ
0	1.02965	15	1070	15	31.27
15	1.01398	30	867	20	30.64
30	0.99825			30	29.39

Refractive index

t°	He r.	He y.	He g.	He v.
15	1.45108	1.45394	1.45872	1.46348
$\frac{dn}{dt}$	0.00042	43	45	45

*Cyclo*pentylfluoride, bromide, iodide and *cyclo*pentylidene chloride: Rogers and Roberts (1946). Perfluorodimethyl*cyclo*pentane and perfluorethyl*cyclo*pentane: Fowler, Hamilton Jr., Kasper, Weber, Burford III and Anderson (1947).

Nona- and Perfluoro-*cyclo*-pentane: Rohrback and Cady (1949).

TRIFLUOROMETHYL-*cyclo*-HEXANE or *Cyclo*-HEXYLFLUOROFORM $C_6H_{11}—CF_3$

Prepared by catalytic hydrogenation of phenylfluoroform.

Constants: Swarts (1923—31)

Boiling point: 107°20 *Melting point:* −103°4 *Density:* 11°5 1.0908

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
20	951	Swarts (1931)	50	648.5	Swarts (1931)
30	829	„	60	575	„
40	733.5	„			

Perfluoromethyl*cyclo*hexane, perfluoro-*o*-dimethyl*cyclo*hexane, perfluoro-*m*-dimethyl*cyclo*hexane, perfluoro-*p*-dimethyl*cyclo*hexane, perfluoro-1,3,5-trimethyl*cyclo*hexane and perfluorohexahydroindane: Fowler, Hamilton, Kasper, Weber, Burford III and Anderson (1947)-

Hexachloro-*cyclo*-hexanes α, β, γ, δ: *Saturated vapour pressure:* Balson (1947).

3. OXYGENATED DERIVATIVES OF THE ALIPHATIC SERIES

A. ALCOHOLS

METHYL ALCOHOL CH_3OH

Methyl alcohol is purified by transformation into a solid ester, either the oxalate according to RAMSAY and YOUNG (1887) or the potassium methyl sulphate according to KLASON and NORLIN (1906).

For the determination of impurities (acetone, formaldehyde, etc.) see BATES, MULLALY and HARTLEY (1923), HARTLEY and RAIKES (1925) and GILLO (1938).

According to GILLO (1938) formaldehyde is determined by SCHIFF's reagent (decolorised fuchsin) down to 10^{-4} %; acetone is determined by the iodoform reaction, by vanillin, by NESSLER's reagent or by ebulliometry and may be detected down to 10^{-3} or 10^{-4} %.

Complete dehydration is obtained by fractional distillation (YOUNG and FORTEY (1902) or by distillation over metallic sodium (CRISMER, 1904; B.E., 1930; GILLO, 1938 [the fifth degree of purity can easily be attained]); distillation over calcium (KLASON and NORLIN, 1906) or magnesium (BJERRUM and ZEICHMEISTER, 1923) is less satisfactory; neither do lime or baryte lead to complete dehydration. Traces of water can be estimated by a determination of the density to the fifth figure; also by measuring of the t°cr.s. in petroleum (CRISMER); T.C.S. in cyclohexane (B.E.); by determining the speed of esterification of methyl oxalate; or by measuring the electrical conductivity of a 10^{-3} N solution of hydrochloric acid (GOLDSCHMIDT, 1924). By measuring crystallization velocities (MICHEL; 1938), it is possible to demonstrate the presence of 0.005 % water. Owing to its hygroscopicity, this substance must be kept in sealed tubes.

Constants B.E. (1930). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
240	29660	—	YOUNG (1910)
240.2	—	0.275	CENTNERSZWER (1904)

Densities of the liquid and the saturated vapour: Young (1900–1910)

t°	L.	V.	t°	L.	V.	t°	L.	V.
0	0.8100	0.0000562	100	0.7140	0.003984	200	0.5530	0.05075
10	0.8008	0.0000996	110	0.7020	0.005376	210	0.5255	0.06521
20	0.7915	0.0001695	120	0.6900	0.007142	220	0.4900	0.08635
30	0.7825	0.0002772	130	0.6770	0.009379	225	0.4675	0.1003
40	0.7740	0.0004394	140	0.6640	0.01216	230	0.4410	0.1187
50	0.7650	0.0006739	150	0.6495	0.01562	232	0.4295	0.1277
60	0.7555	0.001006	160	0.6340	0.01994	234	0.4145	0.1381
70	0.7460	0.001465	170	0.6160	0.02526	236	0.3955	0.1505
80	0.7355	0.002084	180	0.5980	0.03186	238	0.3705	0.1681
90	0.7250	0.002907	190	0.5770	0.04010	238.5	0.3635	0.1789

Rectilinear diameter: $0.4050 - 4479 \cdot 10^{\,7}\, t^{\circ} + 1330 \cdot 10^{-10}\, t^{\circ 2} - 23760 \cdot 10^{-13}\, t^{\circ 3}$

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−44.4	0.986	−54.5	0.379	−66.3	0.110	Mündel (1913)
−46.5	0.820	−57.0	0.295	−67.4	0.102	„
−48.1	0.702	−60.4	0.212			„
−51.9	0.491	−62.5	0.166			„
−10	15.5	120	4751	230	50414	Young (1910)
0	29.6	130	6242	232	52202	„
10	54.7	140	8071	234	53939	„
20	96.0	150	10336	236	55624	„
30	160.0	160	13027	237	56995	„
40	260.5	170	16292	238	57576	„
50	406.0	180	20089	238.5	58329	„
60	625.0	190	24615	239	58741	„
80	1341.0	200	29787	239.5	59145	„
90	1897	210	35770	240	59660	„
100	2621	220	42573			„
110	3561	225	46297			„
15.0	72.4	43.0	292.4	53.9	470.3	Konovalow (1881)
29.3	153.4	43.15	295.0	65.4	756.6	„

t°	p mm		t°	p mm	
18.5	89.1	Joukovsky (1934)	62.53	700	Dorochevsky and Poliansky (1910)
20.0	96.3	„			
20.5	99.0	„	64.57	760	„
30.0	160.2	„	65.92	800	„
49.76	404.6	Bredig and Bayer (1927)	15	73.61	Tower and Germann (1914)
39.76	259.8	„			

Boiling point

64°501	Wojciechowsky (1936)	64°63	De Brouckere and Gillet (1935)
64°509	Stull (1937)	64°65	Atkins and Wallace (1913)
64°51	Maryott (1941)	64°65	B.E. (1930) and Lecat (passim)
64°53	Dorochewsky (1909)	64°7	Young and Fortey (1902)
64°57	Dorochewsky and Poliansky (1910)	64°75	Briscoe and Rinchart (1942)

$\frac{dt}{dp}$ *(10 mm)*

0°33	Ramsay and Young (1887)	0°34	Dorochewsky and Poliansky (1910)
0°34	Dittmar and Fawsitt (1886–87)	0°35	B.E. (1930) and Lecat (passim)

Freezing point

−97°0	B.E. (1930)	−97°68	Roper (1938)
−97°43	Stull (1937)	−97°88	Kelley (1929)

Critical solution point:

in CS_2: 34°9 Roland (1927)
„ 35°2 Maryott ((1941)
in C_6H_{14}: 34°50 Roland (1927)
in C_6H_{12}: 46°05 „

Constants of state

Density

t°	d		t°	d	
0	0.8100	Young (1910)	0	0.81005	B.E. (1930)
10	0.8008	„	15	0.79609	„
20	0.7915	„	30	0.78208	„
0	0.81009	Pesce (1940)	25	0.7866	Briscoe and Rinchart (1942)
25	0.78662	„	30	0.7819	„
45	0.76761	„	40	0.7725	„
			50	0.7628	„
0	0.809985	Rakowski and Frost (1930)	15	0.7960	Mueller and Abegg (1906–1907)
5	0.80535	„			
25	0.78654	„	15	0.79602	Klason and Norlin (1906)
30	0.78181	„	15	0.79602	Dorochewsky (1911)

Density (continued)

20	0.79130	Zepalova-Mikhaïlova (1939)	25	0.78657	Gibson and Kincaid (1937)
20	0.79140	Crismer (1904)	25	0.78658	Barr and Bircumshaw (1921)
20	0.7915	Lowry (1914)	25	0.7866	Larson and Herschel Hunt (1939)
25	0.786525	Jones and Fornwalt (1938)	25	0.786644	Stark and Gilbert (1937)
25	0.78654	Eckfeldt and Lucasse (1943)	25	0.78668	Betts and Hammett (1937)
25	0.78655	Gibson (1935)	25	0.7867	Herz and Schuftan (1922)
25	0.78655	Munn, Anderson and Morris (1942)	25	0.78675	Kelley (1929)

Viscosity

t°	$\eta \cdot 10^5$	
15	623	B.E. (1930)
30	510	,,
25	544	Jones and Fornwalt (1938)

Surface tension

t°	γ	
15	22.99	B.E. (1930)
20	22.55	,,
30	21.69	,,
22	22.47	Kosakewitsch (1928)
25	22.18	Larson and Herschel Hunt (1939)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.32860	1.32897	—	1.33066	1.33372	1.33446	1.33682	1.33752	B.E. (1930)
$\frac{dn}{dt}$	0.00039	0.00040	—	39	39	40	41	39	,,
15	—	—	1.33057	—	—	—	—	—	Dorochewsky (1911
16	—	—	—	1.33023	—	—	—	—	Joukovsky (1934)

Heat constants

Specific heat

t°	c_p	t°	c_p	
L. 3.20	0.5714	23.46	0.6081	Bose (1906) and Bose and Müller (1907)
3.64	0.5727	39.93	0.6112	,,
4.05	0.5742	40.52	0.6115	,,
23.39	0.6050	41.51	0.6120	,,

Specific heat (continued)

t°	c_p	t°	c_p	t°	c_p	
C. −254.36	0.03462	−199.21	0.2620	L. −88.06	0.5204	Kelley (1929)
−251.61	0.04720	−195.55	0.2727	−76.39	0.5239	„
−248.73	0.06156	−191.68	0.2810	−51.47	0.5332	„
−245.91	0.07155	−187.64	0.2902	−37.32	0.5435	„
−242.44	0.08832	−183.87	0.3026	−16.82	0.5526	„
−238.83	0.10730	−179.98	0.3103	− 6.15	0.5660	„
−235.52	0.1237	−175.94	0.3194	+ 0.42	0.5713	„
−232.29	0.1382	−162.02	0.3506	4.65	0.5763	„
−229.23	0.1511	−158.34	0.3584	12.09	0.5838	„
−225.09	0.1687	−155.19	0.3634	19.85	0.5966	„
−217.13	0.2006	−147.79	0.3802			„
−213.63	0.2137	−139.45	0.3946			„
−209.87	0.2264	−125.30	0.4049			„
−203.21	0.2498					„

Heat of vaporisation cal 15°/g.

50°	0.2699	90°	0.2498	Fioch, Ginnings and Holton (1931)
64°7	0.2631	110°	0.2371	„
20°	0.287			Bartoszewiczowna (1931)

Heat of combustion	25° (c_p) 5419.9 cal 15°/g	Rossini (1932)

ETHYL ALCOHOL C_2H_5OH

Osborne, Kelvy and Bearce (1913) have published a very complete monograph concerning the purification and the properties of anhydrous alcohol; this work gives the complete literature until 1913. Previously the most important papers were those of Mendelejeff (1869–1887); Young (1902); Crismer (1904). Among the more recent works concerning anhydrous alcohol, those of Merriman (1913), Brunel, Crenshaw and Tobin (1921) and Brunel (1923) are noteworthy.

Cox has published (1919) a paper on the influence of ether upon the density of absolute alcohol.

Determination of impurities: Gillo (1938): acetaldehyde is determined by means of Schiff's reaction down to 10^{-4} %; methylethylcetone to 10^{-3} % by Nessler's reagent, iodoform, vanillin or ebulliometry; furfurol to 10^{-4} % by means of the aniline-acetic acid reagent.

Because of the existence of the binary constant-boiling mixture with water

(4.4 %), the boiling point of which is only 0°1 lower than that of anhydrous alcohol, absolute alcohol cannot be obtained merely by distillation.

Complete dehydration can be obtained by boiling over lime (this treatment produces traces of aldehyde); also by distillation with a third component such as benzene which yields a ternary constant-boiling mixture with alcohol and water (Young). The course of dehydration can be followed to completeness by determination of the density to the fifth figure or by measuring the speed of saponification of an ester (Kailan, 1911) or by measuring the t°cr.s. in petroleum (Crismer).

Gillo uses CS_2 as a third component and thus obtains, without difficulty, the fifth degree of purity by ebulliometry. This substance must be kept in sealed tubes.

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. mm	d cr.	
243.1	47850	0.2755	Young (1910)

Densities of the liquid and the saturated vapour: Young (1910)

t°	L.	V.	t°	L.	V.	t°	L.	V.
0	0.80625	0.000033	100	0.7157	0.00351	190	0.5782	0.0397
10	0.7979	0.000062	110	0.7057	0.00486	200	0.5568	0.0508
20	0.7894	0.000111	120	0.6925	0.00658	210	0.5291	0.0655
30	0.7810	0.000191	130	0.6789	0.00877	220	0.4958	0.0854
40	0.7722	0.000315	140	0.6631	0.01152	230	0.4550	0.1135
50	0.7633	0.000506	150	0.6489	0.01488	240	0.3825	0.1715
60	0.7541	0.000790	160	0.6329	0.01916	241	0.3705	0.1835
70	0.7436	0.00119	170	0.6165	0.02446	242	0.3546	0.1990
80	0.7348	0.00174	180	0.5984	0.03115	242.5	0.3419	0.2164
90	0.7251	0.00250						

Rectilinear diameter: $0.4028 - 3827 \cdot 10^{-7} t° - 5940 \cdot 10^{-10} t°^{2} + 651 \cdot 10^{-13} t°^{3}$

Young (1900-10)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−99.3	$1.26 \cdot 10^{-3}$	−81.5	$5.96 \cdot 10^{-3}$	−41.0	$296 \cdot 10^{-3}$	Drucker, Jimeno
−95.7	1.74 »	−70.9	17.4 »	−39.3	388 »	and Kangro (1915)
−91.8	2.39 »	−61.2	44.0 »			»
−84.7	4.38 »	−52.6	102.9 »			»

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
−2.05	10.1	11.05	25.0	29.20	75.0	74.37	649.7	**Merriman** (1913)
−0.20	11.8	11.98	26.6	30.04	78.8	76.24	700.7	„
+0.53	12.5	12.30	27.3	34.18	98.8	77.98	750.2	„
0.87	12.8	12.93	28.4	39.71	132.7	78.62	768.5	„
1.39	13.3	13.68	29.7	42.23	150.8	79.60	800.1	„
2.15	13.9	14.01	30.5	47.70	198.1	82.63	899.7	„
2.90	15.0	14.34	30.8	49.68	218.1	85.39	999.6	„
3.99	15.9	14.35	31.1	52.26	247.0	86.01	1021.8	„
4.94	16.8	16.10	34.5	56.46	300.3	87.97	1099.9	„
5.34	17.3	17.50	37.6	59.66	347.8	90.30	1199.6	„
6.25	18.4	20.00	43.6	62.89	400.5	92.55	1301.0	„
7.11	19.4	20.30	44.6	65.55	448.8	94.62	1401.7	„
8.11	20.8	22.08	49.5	68.00	498.7	96.56	1501.1	„
8.74	21.7	24.39	57.2	70.30	549.7	98.39	1599.9	„
9.07	22.3	28.53	72.5	72.30	597.1	99.76	1679.0	„
9.60	23.0							
0	12.24	130	4320	190	18178	241	46210	**Young** (1910)
10	23.77	140	5666	200	22164	242	46917	„
20	44.00	150	7326	210	26821	242.5	47206	„
30	78.06	160	9366	220	32097	243.1	47850	„
90	1194	170	11856	230	38176			„
110	2356	180	14763	240	45504			„
0	11.95	34.988	103.03	50.000	220.94	65.000	438.04	**Kretschmer** and
25.000	59.02	44.994	172.95	54.988	279.79	78.553	766.71	**Wiebe** (1949)
7.9	20	14.5	31	29.6	75	65.5	450	**Kahlbaum** and
8.5	21	15.0	32	34.4	100	68.0	500	**Wirkner** (1898–
9.2	22	15.5	33	42.1	150	70.2	550	„ 1897)
9.8	23	16.0	34	47.8	200	72.4	600	„
10.5	24	16.5	35	52.4	250	74.4	650	„
11.1	25	16.9	36	56.4	300	76.1	700	„
11.7	26	17.4	37	59.9	350	77.6	750	„
12.3	27	18.9	41.3	62.8	400	78.0	760	„
12.9	28	35.5	106.3					„
13.4	29	49.3	215.3					„
14.0	30	65.2	443.8					„
14.0	30.6	27.4	67.4	39.8	133.4	58.0	321.6	**Schmidt** (1891)
16.4	35.4	28.2	70.4	44.4	168.0	59.8	349.7	„
18.4	39.7	29.0	73.8	46.3	184.3	62.6	396.0	„
20.0	43.6	30.4	80.4	49.2	212.5	64.4	429.7	„
22.5	50.8	31.4	84.8	49.8	218.4	66.7	474.2	„
23.9	55.0	32.4	89.4	51.8	241.7	70.1	545.3	„
25.6	60.6	35.0	103.3	53.8	266.0	72.1	594.6	„
26.5	64.2	37.4	116.4	56.2	297.2	78.3	761.3	„

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
18.03	39.11	43.06	155.80	100.27	1741.5	Crafts (1913)
30.74	81.15	89.66	1172.7			„
18.7	41.3	49.5	215.3	78.55	766.5	Konovalow (1881)
35.5	106.3	65.4	443.8			„
21.81	47.6	59.92	351.0	75.36	676.8	Schouteden and Deveux (1936)
30.41	82.2	65.50	448.9	80.65	840.3	„
50.44	224.4	70.33	549.3	85.97	979.9	„
38.26	123.53	57.47	315.27	68.71	506.53	Dreisbach and Shrader (1949)
78.545	767.45	91.786	1268.50	100.832	1742.45	Swietoslawski and Zlotowski
86.101	1026.30	96.520	1500.00	103.320	1900.10	„ (1930)
15	32.18					Tower and Germann (1914)
15	32.6					Bachmann (1917)
30	78.3					Ferguson, Freed and Mooris (1933)

Boiling point

78°2	Schmidt (1891)	78°32	Lecat (passim)
78°2	Brown (1903)	78°32	(Mg) Frost (1930)
78°20	Kahlbaum (1883)	78°35	(Ca) „
78°27	Dreisbach and Martin (1949)	78°325	Wojciechowski (1936)
78°3	Piatti (1930–31)	78°33	Kretschmer and Wiebe (1949)
78°3	Marshall (1906)	78°34	Maryott (1941)
78°3	Richards and Davis (1920)	78°35	Dorochewsky and Poliansky (1910)
78°3	Merriman (1913)	78°35	Zepalova-Mikhaïlova (1937–39)
78°3	Maass and Boomer (1922)	78°35	Doulizkaya (1945) (99.98 %)
78°3	Young (1910)	78°36	Winkler (1905)
78°3	Rieder and Thompson (1949)	78°4	Mündel (1913)
78°30	Barbaudy (1927)	78°4	Faust (1912)
78°32	Brunel, Crenshaw and Tobin (1921)	78°4	Pollock, Collett and Lazzell (1946)
78°32	Tyrer (1914)	78°41	Dupre and Page (1869)
78°32	Grimm and Patrick (1923)	78°42	Richards and Coombs (1915)
78°32	Crafts (1887–1913)		

$\frac{dt}{dp}$ *(10 mm)*

0°3286	Dreisbach and Martin (1949)
0°33	Crafts (1887–1913)
0°332	Merriman (1913)
0°334	Wojciechowski (1936)
0°34	Dorochewsky and Poliansky (1910)
0°34	Winkler (1905)

Freezing point: –114°15 Timmermans (passim)
—114°49 Dreisbach and Martin (1949)

Critical solution point: in CS_2: –23°5 Maryott (1941)

Constants of state

Density

t°	d	
0	0.80625	Young (1910)
10	0.7979	,,
20	0.7894	,,
0	0.80625	Mendelejeff (1869)
5	0.80207	,,
10	0.79788	,,
15	0.79367	,,
20	0.78945	,,
25	0.78522	,,
30	0.78096	,,
0	0.806306	Kretschmer, Nowakowska and Wiebe (1948)
25	0.785063	,,
50	0.763137	,,
0	0.80628	Merriman (1913)
0	0.80629	Wade and Merriman (1912)
15	0.793559	Frost (1930)
15	0.79357	Zepalova-Mikhaïlova (1939)
15	0.79367	Dorochewsky (1911)
17.5	0.79156	Fresenius and Grünhut (1912)
15	0.79367	Crismer (1904–6)
20	0.78945	,,
0	0.80625	Timmermans (1923)
0	0.80629	Winkler (1905)
5	0.80209	,,
10	0.79787	,,
15	0.79363	,,
20	0.78937	,,
25	0.78509	,,
30	0.78079	,,
20	0.78934	Solona and Moles (1932)
20	0.789344	Riiber (1923)
25	0.78503	Lund and Bjerrum (1931)
25	0.78505	Brunel, Crenshaw and Tobin (1921)
25	0.78506	Robertson and Acree (1913)
25	0.78506	Osborne, Kelvy and Bearce (1913)
25	0.78506	Davis and Johnson (1918)
25	0.78506	Barbaudy (1926)
25	0.78508	Kretschmer and Wiebe (1949)
25	0.78510	Andrews (1908)
25	0.78510	Moesveld (1923)

$d\ t^\circ = 0.80625 - 84.5 \cdot 10^{-5}\ t^\circ + 29 \cdot 10^{-8}\ t^{\circ 2}$ (below 0°) Timmermans (1923)

Viscosity

t°	$\eta \cdot 10^3$	t°	$\eta \cdot 10^3$	t°	$\eta \cdot 10^3$	
7.16	15.328	31.89	9.560	55.57	6.354	Thorpe and Rodger
13.27	13.573	37.51	8.644	61.07	5.815	„ (1894)
19.22	12.094	42.84	7.875	67.55	5.263	„
25.24	10.792	49.37	7.047	73.57	4.764	„
30.00	9.91	78.27	4.42	120.00	2.47	Titani (1927)
40.00	8.23	80.00	4.35	130.00	2.17	„
50.00	7.01	90.00	3.76	140.00	1.93	„
60.00	5.91	100.00	3.25	150.00	1.66	„
70.00	5.03	110.00	2.85			„
25	10.68	Guy and Jones		14.53	13.17	Tower (1916)
35	8.683	„ (1911)		25	10.78	Hughes and Hartley (1933) and Barak and Hartley (1933)
45	7.292	„				
0	17.85	Walden (1906)				
25	10.75	„		25	10.8	Thole (1914)

Surface tension

t°	γ		t°	γ	
15	22.76	Hennaut-Roland and Lek (1931)	20	22.27	Richards and Coombs (1915)
20	22.32	„	20	22.28	Zepalova-Mikhaïlova (1937)
30	21.48	„	22	21.96	Trieschmann (1935)
25	21.85	Larson and Herschel Hunt (1939)			

Refractive index

t°	D		t°	D	
15°	1.36330	Dorochewsky (1911)	25°	1.3595	Munch (1926)
15°5	1.36316	Holmes (1913)	25°	1.3596	Müller and Geurdjikoff (1912)
20°	1.36139	Smyth and Stoops (1929)			
20°	1.3614	Pollock, Collett and Lazzell (1946)	25°	1.3596	Ernst, Watkins and Ruwe (1936)
25°	1.359408	Andrews (1908)	25°5	1.3595	Brunel, Crenshaw and Tobin (1921)

Dielectric constant

t°	ε		t°	ε	
0	27.88	Le Fevre (1938)	45	21.53	Le Fevre (1938)
10	26.41	„	55	20.21	„
20	25.00	„			
25	24.25	„	25	24.14	Larson and Herschel Hunt (1939)
35	22.79	„			

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −254.50	0.03162	−218.90	0.1588	−176.96	0.2390	Kelley (1929)
−251.16	0.04313	−214.49	0.1688	−173.10	0.2451	(M.W. 46.05)
−248.35	0.05688	−210.54	0.1796	−169.09	0.2525	„
−245.68	0.06932	−206.95	0.1879	−164.40	0.2585	„
−242.73	0.07888	−203.24	0.1965	−159.60	0.2666	„
−240.35	0.08748	−200.01	0.2006	−155.48	0.2718	„
−236.67	0.09918	−195.59	0.2068	−151.30	0.2796	„
−233.11	0.1107	−191.45	0.2143	−147.17	0.2839	„
−229.55	0.1249	−187.63	0.2225	−142.98	0.2861	„
−226.43	0.1382	−183.05	0.2292	−140.61	0.2915	„
−223.03	0.1485	−180.65	0.2325			„
L. −109.65	0.4502	−80.55	0.4615	−13.60	0.5160	„
−105.26	0.4515	−77.18	0.4617	− 7.68	0.5212	„
−100.94	0.4532	−75.82	0.4626	− 2.14	0.5299	„
− 96.51	0.4548	−65.03	0.4726	+ 4.36	0.5427	„
− 91.93	0.4593	−60.22	0.4732	15.79	0.5625	„
− 87.59	0.4606	−55.52	0.4826	21.15	0.5701	„
− 81.48	0.4611	−34.97	0.4928			„
C. −186.1	0.231	−173.1	0.251	−143.1	0.296	Parks (1925)
−183.1	0.236	−163.1	0.266	−133.1	0.312	„
−178.1	0.244	−153.1	0.281			„
L. −113.1	0.455	− 33.1	0.507	16.9	0.572	„
− 73.1	0.468	+ 1.9	0.543	24.9	0.588	„
− 43.1	0.496					„
L. 30	0.603	45	0.653	60	0.705	Blacet, Leighton
35	0.614	50	0.669	65	0.723	and Bartlett
40	0.633	55	0.688	70	0.753	„ (1931)

Heat of vaporisation cal 15°/g

50°	211.9	90°	195.7	Fiock, Ginnings and Holton (1931)
70°	204.5	110°	185.9	„

Heat of melting cal 15°/g

−114°4	25.76	Parks (1925)
−114°6	26.05	Kelley (1929)

Heat of combustion	25° (c_p) 7092.9 cal 15°/g	Rossini (1932)

n-PROPYL ALCOHOL C_3H_7OH

n-Propyl alcohol, obtained by a fermentation process, contains an impurity which cannot be eliminated without recrystallization in the form of a solid derivative: the phthalate. *n*-Propyl alcohol gives with water an azeotrope boiling 10° lower than the anhydrous alcohol. This compound can be dehydrated by distillation with a good dephlegmator (YOUNG, 1910), or by boiling with CaO (CRISMER, 1904) or Mg (LUND and BJERRUM, 1931). Criteria of purity are the density to the fifth figure (BRUNEL, 1923) and the critical temperature of solution in petroleum (CRISMER, 1904).

Constants: B.E. (1934). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
263.7	38120	0.2734	YOUNG (1910)

Densities of the liquid and the saturated vapour: YOUNG (1910)

t°	L.	V.	t°	L.	V.	t°	L.	V.
80	0.7520	0.00104	150	0.6740	0.01060	220	0.5485	0.0556
90	0.7425	0.00156	160	0.6600	0.01380	230	0.5230	0.0704
100	0.7325	0.00226	170	0.6450	0.01770	240	0.4920	0.0904
110	0.7220	0.00320	180	0.6285	0.0225	250	0.4525	0.1180
120	0.7110	0.00443	190	0.6110	0.0282	260	0.3905	0.1610
130	0.6995	0.00605	200	0.5920	0.0353	263.15	0.3450	—
140	0.6875	0.00805	210	0.5715	0.0442	263.5	0.3380	—

Rectilinear diameter: $0.4095 - 379 \cdot 10^{-6} t^{\circ} - 375 \cdot 10^{-9} t^{\circ 2} - 5533 \cdot 10^{-13} t^{\circ 3}$

YOUNG (1900—10)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−15.7	1.036	−23.1	0.549	−29.7	0.295	Mündel (1913)
−18.4	0.815	−26.2	0.403	−43.3	0.0068	„
0	3.44	100	842.5	200	12801	Young (1910)
10	7.26	110	1206	210	15575	„
20	14.5	120	1683	220	18679	„
30	27.6	130	2293	230	22154	„
40	50.2	140	3074	240	26194	„
50	87.2	150	4052	250	30785	„
60	147.0	160	5264	260	36103	„
70	239.0	170	6695	263.7	38120	„
80	376.0	180	8383			„
90	574.0	190	10466			„
2.3	4.59	35.1	39.81	59.7	143.0	Richardson (1886)
4.8	5.19	36.7	40.81	62.5	163.96	„
6.2	5.78	38.2	45.50	66.2	214.75	„
10.8	7.84	39.2	47.40	68.7	220.74	„
11.45	8.56	41.7	54.88	74.5	287.3	„
11.7	8.83	43.7	61.67	75.2	300.67	„
13.2	9.49	44.7	65.21	79.2	358.75	„
14.9	10.96	46.7	73.50	81.9	400.67	„
20.7	15.46	48.7	85.53	85.7	477.51	„
23.7	18.82	53.9	106.92	90.2	566.22	„
28.2	24.96	55.7	119.25	94.1	711.01	„
30.6	29.04	56.5	129.23	97.2	746.45	„
33.8	34.90					„

Boiling point

97°1	Mündel (1913)	97°19	Grimm and Patrick (1923)
97°15	B.E. (1934)	97°2	Lecat (passim)
97°15	Zepalova-Mikhaïlova (1937)	97°20	Dorochewsky (1909)
97°175	Brunel (1923)	97°209	Wojciechowski (1936)
97°19	Young and Fortey (1903)	97°26	Dorochewsky (1911)
97°19	Carley and Bertelsen (1949)		

$\frac{dt}{dp}$ *(10 mm)*

0°38	B.E. (1934)	0°37	Lecat (passim)

Freezing point: —126°1 Parks and Huffman (1926)

Constants of state

Density

t°	d	t°	d	t°	d	
20	0.8035	40	0.7875	60	0.7700	Young (1910)
30	0.7960	50	0.7785	70	0.7610	„

t°	d		t°	d	
0	0.81920	B.E. (1934)	0	0.81926	Timmermans (1923)
15	0.80749	„	0	0.81923	Young and Fortey (1902)
30	0.79567	„	17	0.8061	Schmidt (1926)
20	0.8035	Lowry (1914)	25	0.79968	Holmes and Sageman (1909)
20	0.8035	Hatem (1949)	25	0.79985	Brunel (1923)
20	0.80357	Zepalova-Mikhaïlova (1937)	25	0.7999	Parks and Huffman (1926)
20	0.80358	Crismer (1904)			

$d_{t°} = 0.81926 - 76.9 \cdot 10^{-5}\, t° + 65 \cdot 10^{-8}\, t°^2$ (at low temperatures) Timmermans (1923)

Viscosity

t°	$\eta \cdot 10^5$	
15	2522	B.E. (1934)
30	1722	„

Surface tension

t°	γ		t°	γ	
15	24.09	B.E. (1934)	20	23.78	Brown (1932)
20	23.70	„	20	23.73	Zepalova-Mikhaïlova (1937)
30	22.89	„			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.38470	1.38501	—	1.38706	1.39081	1.39178	1.39473	B.E. (1934)
$\frac{dn}{dt}$	0.00037	37	—	38	39	39	40	„
23.6	1.3818	—	1.3840	—	—	—	—	Beynon (1941)

Values for other wavelengths are given by Beynon (1941)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −184.8	0.207	−166.1	0.237	−151.0	0.261	PARKS and HUFFMAN
−178.9	0.216	−159.8	0.246	−150.3	0.262	„ (1926)
−172.9	0.226	−159.5	0.246	−145.4	0.272	„
−172.0	0.227					„
L. −120.5	0.425	−79.0	0.442	−71.5	0.447	„
−104.0	0.430	−74.1	0.444	+ 1.9	0.531	„
− 87.5	0.436					„
L. 3.52	0.5332	27.32	0.5755	41.91	0.5983	BOSE (1906—7)

Heat of vaporisation	179.9 cal 15°/g	BARTOSZEWICZOWNA (1931)
Heat of melting	20.66 „	PARKS and HUFFMAN (1926)

Iso-PROPYL ALCOHOL $(CH_3)_2.CHOH$

Iso-propyl alcohol gives with water an azeotrope, having a boiling point 2° lower than the pure alcohol; dehydration by fractional distillation is thus a rather delicate and wasteful operation. Addition of benzene followed by distillation leads to complete elimination of water as a ternary azeotrope boiling at 66°5. The excess of benzene distils at 71°9 giving also an azeotrope with isopropyl alcohol (YOUNG and FORTEY, 1902). The alcohol can also be dehydrated by boiling over lime or baryta.

Constants: B.E. (1934)

Critical temperature: 243°47 BROWN (1906)

Saturated vapour pressure: PARKS and BARTON (1928)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
0.00	8.9	25.00	44.0	50.00	176.8	75.00	561.4
5.00	12.1	30.00	59.1	55.00	227.4	80.00	691.8
10.00	17.0	35.00	78.9	60.00	288.5	85.00	845.6
15.00	23.8	40.00	105.6	65.00	363.1	90.00	1020.7
20.00	32.4	45.00	136.8	70.00	454.8		

Boiling point

82°2	Ginnings and Corruccini (1948)	82°4	Clough and Jones (1923)
82°258	Brunel (1923)	82°40	B.E. (1934)
82°26	Brunel, Crenshaw and Tobin (1921)	82°42	Lecat (passim)
82°29	Swietoslawski (1934)	82°44	Young and Fortey (1902)

$\frac{dt}{dp}$ (10 mm)

0°33	Brunel, Crenshaw and Tobin (1921)	0°35	B.E. (1934) and Lecat (passim)

Freezing point: −89°5 B.E. (1934)

Density

t°	d		t°	d	
0	0.80136	B.E. (1934)	25	0.78084	Brunel (1923)
15	0.78916	"	25	0.78086	Parks and Kelley (1925)
30	0.77690	"	25	0.78087	Olsen and Washburn (1935)
0	0.80120	Young and Fortey (1902)	25	0.78091	Parks and Barton (1928)
20	0.78512	Zepalova-Mikhaïlova (1937)	25	0.78095	Kelley (1929)

Viscosity

t°	$\eta \cdot 10^5$	
15	2859	B.E. (1934)
30	1765	"

Surface tension

t°	γ	
15	21.79	B.E. (1934)
20	21.35	"
30	20.96	"

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	
15	1.37688	1.37719	1.37913	1.38288	1.38375	1.38679	B.E. (1934)
$\frac{dn}{dt}$	0.00034	34	34	34	34	34	,,
20	—	—	1.3775	—	—	—	Fischer and Reichel (1943)

Specific heat: Ginnings and Corruccini (1948)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
0	0.541	40	0.670	100	0.848	160	0.983
20	0.596	60	0.742	120	0.894	180	1.024
		80	0.798	140	0.939	200	1.062

Heat of vaporisation	20°	175.6 cal 15°/g	Bartoszcewiczowna (1931)
Heat of melting	−88°43	21.37 ,,	Kelley (1929)

n-BUTYL ALCOHOL C_4H_9OH

n-Butyl alcohol only became an easily available material thirty years ago. This alcohol is easily dehydrated by fractional distillation since its azeotrope with water boils 26° lower than the alcohol itself.

Constants: B.E. (1928). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	
287.0	36775	Herz and Neukirsch (1923)

Saturated vapour pressure: Kahlbaum (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
15.1	3	40.6	19	50.6	35	58.6	55
18.7	4	41.5	20	51.1	36	60.2	60
21.7	5	42.2	21	51.5	37	61.6	65
24.0	6	42.9	22	52.0	38	63.0	70
26.1	7	43.6	23	52.5	39	64.3	75
27.9	8	44.3	24	52.9	40	69.8	100
29.5	9	45.0	25	53.4	41	78.1	150
31.0	10	45.6	26	53.8	42	84.3	200
32.4	11	46.2	27	54.2	43	89.4	250
33.6	12	46.8	28	54.6	44	93.7	300
34.8	13	47.4	29	55.0	45	97.4	350
35.9	14	48.0	30	55.4	46	100.8	400
36.9	15	48.6	31	55.8	47	103.7	450
37.9	16	49.1	32	56.1	48	106.3	500
38.9	17	49.6	33	56.5	49	108.8	550
39.7	18	50.1	34	56.9	50		

Boiling point

117°7	Brunjes and Furnas (1935)	117°8	Allen, Lingo and Felsing (1939)
117°7	Verkade and Coops (1927)	117°8	Brunjes and Bogart (1943)
117°71	Grimm and Patrick (1923)	118°0	B.E. (1928)
117°726	Wojciechowski (1936)	118°0	Keffler and Mac Lean (1935)
117°8	Lecat (passim)	118°0	Zepalova-Mikhaïlova (1939)

$\frac{dt}{dp}$ *(10 mm)*

0°36	Lecat (passim)	0°372	Wojciechowski (1936)
0°37	B.E. (1928)		

Freezing point: —89°8 Timmermans (passim)

Constants of state

Density

t°	d		t°	d	
0	0.82472	B.E. (1928)	0	0.8246	Jones and Christian
15	0.81337	,,	25	0.80572	,, (1938)
30	0.80206	,,			
15.5	0.8130	Eykman (1893–1919)	25	0.8057	Allen, Lingo and Felsing (1939)
20	0.80961	Zepalova-Mikhaïlova (1937)	25	0.8057	Larson, and Herschel Hunt (1939)
25	0.80567	Brunjes and Bogart (1943)	34.6	0.7986	Verkade and Coops (1927)

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	3379	B.E. (1928)	15	25.00	HENNAUT-ROLAND and LEK
30	2271	„	20	24.57	„ (1931)
			30	23.75	„
			25	24.2	LARSON and HERSCHEL HUNT (1931)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.39886	1.39913	1.40118	1.40130	1.40521	1.40612	1.40904	1.40997	B.E. (1928)
$\frac{dn}{dt}$	—	0.00039	39	—	—	40	—	40	„
25	—	—	1.3974	—	—	—	—	—	ALLEN, LINGO and FELSING (1939)
25	—	—	1.3970	—	—	—	—	—	BRUNJES and BOGART (1943)

Heat constants

Heat of vaporisation	20° 149.4 cal 15°/g	BARTOZCEWICZOWNA (1931)
Heat of melting	29.93 „	PARKS (1925)

Iso-BUTYL ALCOHOL $(CH_3)_2CH.CH_2OH$

This is easily obtained pure and water-free by fractional distillation since it gives, with water, a azeotrope boiling 18° lower than the alcohol itself.

Constants: B.E. (1928) – **Polyphasic equilibria**

Critical temperature: 279°07 BROWN (1906)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
14.75	5.8	50.45	55.5	70.7	160.65	91.0	395.2	KONOVALOW
30.85	17.7	60.4	94.1	80.0	246.0	99.9	570.3	„ (1881)

Satured vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
25.3	11.212	61.3	98.68	75.9	204.06	91.55	399.35	Richardson
32.8	18.44	62.3	103.043	77.2	213.77	92.8	418.12	„ (1886)
35.4	21.426	65.8	123.920	78.7	229.45	92.95	428.94	„
37.9	26.160	66.0	124.617	81.3	259.001	95.40	468.978	„
42.0	33.123	67.75	134.85	83.6	284.30	95.8	478.117	„
46.7	44.069	69.9	151.20	84.8	297.587	98.05	524.86	„
50.8	55.666	71.8	166.62	85.3	304.47	100.7	575.651	„
52.8	62.68	73.8	182.38	87.3	332.32	101.55	593.86	„
54.9	71.61	74.8	194.68	90.3	378.12	102.75	626.264	„
58.8	85.86					104.8	669.113	„
						105.8	708.36	„
20	8.8	—	—	—	—	—	—	Faust (1912)

Boiling point

107°89	Brunel, Crenshaw and Tobin (1921)	107°98	Allen, Lingo and Felsing (1939)
107°894	Bylewski (1932)	108°01	Lecat
107°93	Dorochewsky and Dworzancyck (1908)	108°06	Young and Fortey (1902)
		108°10	B.E. (1928)

$\frac{dt}{dp}$ *(10 mm)*

0°35	B.E. (1928)	0°36	Lecat

Constants of state

Density

t°	d		t°	d	
0	0.81707	B.E. (1928)	0	0.81698	Young and Fortey (1902)
15	0.80576	„	16.35	0.80459	„
30	0.79437	„			
15	0.80563	Dorochewsky (1909–11)	25	0.7982	Allen, Lingo and Felsing (1939)
19.8	0.8021	Hückel and Ackerman (1932)	25.6	0.7977	Eykman (1919)
20	0.80196	Bylewski (1932)			

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	4703	B.E. (1928)	15	23.42	HENNAUT-ROLAND and LEK (1931)
30	2876	,,	20	22.98	,,
			30	22.11	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.39554	1.39569	1.39768	1.39785	1.40190	1.40270	1.40581	1.40679	B.E. (1928)
$\frac{dn}{dt}$	0.00038	38	39	39	39	39	40	40	,,
15	—	—	1.39750	—	—	—	—	—	DOROCHEWSKY (1911)
20	—	—	1.3959	—	—	—	—	—	LONGINOW and PRJANISCHNIKOW (1931)
25	—	—	1.3939	—	—	—	—	—	ALLEN, LINGO and FELSING (1939)
25.6	1.39167	1.39194	1.39750	1.39396	1.39779	1.39872	1.40149	1.40258	EYKMAN (1919)

Heat constants

Heat of vaporisation	20° 147.1 cal 15°/g	BARTOSZCEWICZOWNA (1931)

sec-BUTYL ALCOHOL $CH_3.CH_2.CHOH.CH_3$

This compound has been studied thoroughly by TIMMERMANS and his co-workers on account of the particular characters shown by its curve of solubility in water; and by PICKARD and KENYON, for the rotatory power of its optical antipodes.

The technical product is obtained by catalytic reduction of methylethylketone. It forms an azeotrope with water, which boils 11° lower than the pure alcolhol. A careful fractional distillation yields the alcohol pure and dry; the samples obtained in this way show the same density for a series of successive fractions and the properties of the latter do not alter either when regenerated after having been transformed into acid phthalate or after treatment with lime.

The constants of the racemic compound are identical with those of the optical antipodes.

Constants: B.E. (1928)

Critical temperature: 265°19 Brown (1906)

Saturated vapour pressure: Roland (1928)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
0.32	2.8	12.0	7.1	20.05	12.7	39.9	44.6
9.68	6.4	15.22	9.1	29.98	24.2	49.7	79.5

Boiling point

99°5	Timmermans (1911)	99°50	$\frac{dt}{dp}$ *(10 mm):* 0°40 B.E. (1928)
99°5	Houston (1933)	99°52	„ 0°39 Lecat (passim)

Density

t°	d. (active)	d. (racemic)
0	0.82275	0.82273
15	0.81088	0.81089
30	0.79895	0.79898

Viscosity

t°	$\eta \cdot 10^5$
15	4210
30	3180

Surface tension

t°	γ
15	23.89
20	23.47
30	22.62

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	—	1.39730	1.39946	1.39946	—	1.40434	—	1.40835	B.E. (1928)
$\frac{dn}{dt}$	—	0.00046	49	49	—	48	—	49	„
19.1	1.39511	1.39539	—	1.39743	1.40126	1.40218	1.40494	1.40604	Eykman (1919)

Rotatory power

t°	Li r.	Li or.	Na	He y.	Hg g.	Li bl.	Hg v.	
20	10.50	12.84	13.87	14.45	16.36	23.94	27.14	B.E. (1928)

TRIMETHYLCARBINOL or *tert*-BUTYL ALCOHOL $C(CH_3)_3OH$

This is purified by alternate fractional freezing and fractional distillation. It gives a constant-boiling mixture with water, but the boiling point of the mixture (79°9) is so near to that of the pure alcohol (82°45), that it is best purified by fractional distillation in the presence of benzene (Young and Fortey, 1902). The melting point and density constitute the best criteria of purity.

Constants: B.E. (1934). — **Polyphasic equilibria**

Saturated vapour pressure: Parks and Barton (1928)

t°	p mm	t°	p mm	t°	p mm
20.00	30.6	45.00	133.8	70.00	447.3
25.00	42.0	50.00	174.3	75.00	553.2
30.00	56.9	55.00	224.2	80.00	679.4
35.00	76.3	60.00	285.2	85.00	826.3
40.00	102.3	65.00	358.2	90.00	996.2

Boiling point

82°45	Lecat (passim)	82°55	Swarts (1929)
82°50	B.E. (1934)	82°57	Dorochewsky (1911)
82°55	Young and Fortey (1902)	$\frac{dt}{dp}$ *(10 mm)*: 0°29 B.E. (1934)	

Melting point

25°4	Parks and Anderson (1926)	25°53	Young and Fortey (1902)
25°45	de Forcrand (1903)	25°55	B.E. (1934)
25°5	Marsden and Evans (1937)	25°66	Simonsen and Washburn (1946)
25°50	Parks and Barton (1928)	25°00	(second cryst. form) "

Constants of state

Density

t°	d		t°	d	
20	0.78670	B.E. (1934)	22	0.78462	Spells (1936)
30	0.77620	"	27.1	0.7791	Eykman (1919)
35	0.77090	"	27.2	0.7792	Swarts (1929)

Viscosity

t°	$\eta \cdot 10^5$	
30	3316	B.E. (1934)
35	2575	,,
40	2039	,,

Surface tension

t°	γ	
15	20.02	B.E. (1934)
20	19.56	,,
30	19.10	,,

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	
25	1.38286	1.38315	1.38520	1.38912	1.38996	1.39296	B.E. (1934)
$\frac{dn}{dt}$	0.00048	48	49	49	49	50	,,
27	1.38196	—	1.38426	1.38802	—	1.39169	Marsden and Evans (1937)

For other wavelengths, see: Marsden and Evans (1937)

Heat constants

Specific heat: Parks and Anderson (1926)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −186.06	0.178	−167.06	0.207	−112.46	0.290	−69.66	0.362
−179.96	0.188	−164.96	0.210	− 80.16	0.342	−57.16	0.385
−173.36	0.198	−160.86	0.216	− 76.46	0.349	−44.86	0.408
−170.66	0.200	−119.66	0.282	− 73.46	0.354	−29.76	0.443
L. + 26.9	0.725	+ 27.2	0.728	—	—	—	—

n-AMYL ALCOHOL $C_5H_{11}OH$

This alcohol is obtained in a pure state only by synthesis. This involves the reaction between trioxymethylene (or gaseous formaldehyde) and *n*-butyl-magnesium bromide. Fractional distillation gives a pure product, yet all the old samples were impure.

Constants B.E. (1932)

Boiling point

137°95	Lievens (1924)	138°2	Lecat (passim)
138°00	Simon (1929)	138°25	B.E. (1932)
138°06	Wojciechowski (1936)	$\frac{dt}{dp}$ *(10 mm)* 0°37 B.E. (1932) and Simon (1929)	

Freezing point: –78°85 B.E. (1932)

Density

t°	d	
0	0.82897	B.E. (1932) and SIMON
15	0.81837	„ „ (1929)
30	0.80764	„ „
34.6	0.8041	VERKADE and COOPS (1927)

Viscosity

t°	$\eta \cdot 10^5$	
15	4650	B.E. (1932) and SIMON
30	2987	„ (1929)

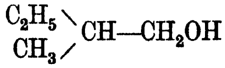
Surface tension

t°	γ	
15	26.03	B.E. (1932) and HENNAUT-ROLAND and LEK (1931)
20	25.60	„
30	24.72	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.40930	1.40955	1.41173	1.41185	1.41580	1.41674	1.41990	1.42111	B.E. (1932) and SIMON
$\frac{dn}{dt}$	0.00036	35	35	36	37	36	37	37	„ (1929)

Active AMYL ALCOHOL or *sec*-BUTYLCARBINOL



$$\begin{matrix} C_2H_5 \diagdown \\ CH_3 \diagup \end{matrix} CH—CH_2OH$$

This compound is obtained from amyl alcohol by a fermentation process and fractional crystallization of a suitable ester such as the trinitrophthalate.

Constants: MARCKWALD and MAC KENZIE (1901)

Boiling point: 128°

Specific rotatory power

λ	665.9	589.2	532.0	488.5	448.2
20°	–4.42	–5.90	–7.44	–8.03	–11.76

Iso-AMYL ALCOHOL or *iso*-BUTYLCARBINOL $(CH_3)_2CH.CH_2.CH_2OH$

Most authors have obtained a relatively impure product by the fractionation of fusel oil; the only satisfactory synthesis consists in allowing trioxymethylene to react with pure *iso*-butyl-magnesium bromide.

Constants: TIMMERMANS and HENNAUT-ROLAND (1929)

Critical temperature: 309°77 BROWN (1906)

Boiling point

131°9	$\frac{dt}{dp}$ *(10 mm):* 0°34 LECAT (passim)
132°0	„ 0°30 TIMMERMANS and HENNAUT-ROLAND (1929)
132°05	YOUNG and FORTEY (1902)

Density

t°	d		t°	d	
0	0.82392	TIMMERMANS and HENNAUT-	0	0.8238	BALBIANO (1876)
15	0.81294	„ ROLAND (1929)	15	0.81282	PERKIN (1884)
30	0.80179	„	25	0.80540	„

Viscosity

t°	$\eta \cdot 10^5$	
15	4811.1	TIMMERMANS and HENNAUT-ROLAND (1929)
30	2961	

Surface tension

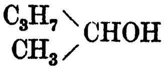
t°	γ	
15	24.77	TIMMERMANS and HENNAUT-ROLAND (1929)
20	24.32	
30	23.44	„

Refractive index

t°	Hα	He y.	He g.	Hβ	He v.	Hγ	
15	1.40633	1.40851	1.41240	1.41352	1.41648	1.41783	TIMMERMANS and HENNAUT-ROLAND (1929)
$\frac{dn}{dt}$	1.00036	37	—	38	—	40	„
22.1	1.4038	—	—	—	—	—	BARBIER and ROUX (1890)

Magnetic rotatory power: 18°6 0.9891 PERKIN (1884)

Sec-AMYL ALCOHOL or METHYLPROPYLCARBINOL



$$\begin{matrix} C_3H_7 \searrow \\ CH_3 \nearrow \end{matrix} CHOH$$

This substance is prepared from acetaldehyde and *n*-propyl-magnesium bromide. Paraldehyde (b.p.: 124°) forms an azeotrope (118°5) which is difficult to separate; the alcohol is unstable at the boiling point.

Constants: B.E. (1912)

Boiling point

119°8	Lecat (passim)	119°85	$\frac{dt}{dp}$ *(10 mm):* 0°39 B.E. (1932)

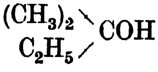
Density *Viscosity* *Surface tension*

t°	d		t°	$\eta \cdot 10^4$		t°	γ
0	0.82470		15	513		15	24.42
15	0.81319		30	278		20	23.98
30	0.80120					30	22.96

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.40592	1.40629	1.40851	1.41244	1.41345	1.41659
$\frac{dn}{dt}$	0.00041	41	41	42	43	44

Tert-AMYL ALCOHOL or DIMETHYLETHYLCARBINOL



$$\begin{matrix} (CH_3)_2 \searrow \\ C_2H_5 \nearrow \end{matrix} COH$$

Constants: B.E. (1932)

Critical temperature: 271°77 Brown (1906)

Boiling point

102°27	Parks, Huffman and Barmore (1933)	102°35	$\frac{dt}{dp}$ *(10 mm):* 0°37 B.E. (1932)
102°32	Atkins and Wallace (1913)	102°35	„ 0°36 Lecat (passim)

Freezing point

−8°6	B.E. (1932)
−9°1	Parks, Huffman and Barmore (1933)

Density

t°	d
0	0.82718
15	0.81346
30	0.79974

Viscosity

t°	$\eta \cdot 10^4$
15	548
30	281

Surface tension

t°	γ
15	23.22
20	22.77
30	21.84

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.40468	1.40495	—	1.40726	1.41126	1.41226	1.41526	B.E. (1932)
$\frac{dn}{dt}$	0.00043	42	—	43	43	43	45	„
25	—	—	1.4020	—	—	—	—	MUNCH (1926)

DIETHYLCARBINOL $(C_2H_5)_2CHOH$

Constants: B.E. (1932)

Boiling point

116°0	LECAT (passim)
116°10	$\frac{dt}{dp}$ *(10 mm):* 0°35 B.E. (1932)

Density

t°	d
0	0.83681
15	0.82466
30	0.81180

Viscosity

t°	$\eta \cdot 10^5$
15	7337
30	3306

Surface tension

t°	γ
15	25.02
20	24.60
30	23.76

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.40992	1.41026	1.41249	1.41639	1.41743	1.42049
$\frac{dn}{dt}$	0.00046	45	46	47	46	48

n-HEXYL ALCOHOL $n\text{-}C_6H_{13}OH$

Prepared by reducing ethyl caproate with sodium in absolute alcohol.

Constants

Boiling point

157°47	$\frac{dt}{dp}$ *(10 mm):* 0°39	Bilterys (1935)
157°85		Lecat (passim)

Density

t°	d	
0	0.83285	Bilterys (1935)
15	0.82239	„
30	0.81201	„

Viscosity

t°	$\eta \cdot 10^5$	
15	6203	Bilterys (1935)
30	3872	„

Surface tension

t°	γ	
15	24.94	Hennaut-Roland and Lek (1931)
20	24.48	„
30	23.68	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	
15	1.41685	1.41722	1.41935	1.42338	1.42434	Bilterys (1935)
$\frac{dn}{dt}$	0.00035	34	34	34	34	„

Specific heat: Kelley (1929)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −254.88	0.01512	−212.19	0.1131	−152.85	0.2001	L. −43.52	0.4170
−246.05	0.03406	−206.83	0.1239	−144.50	0.2128	−32.97	0.4287
−242.44	0.04265	−202.15	0.1318	−136.38	0.2204	−22.43	0.4354
−237.80	0.05444	−196.64	0.1409	−127.34	0.2299	−12.46	0.4460
−232.75	0.06666	−187.78	0.1548	−119.07	0.2395	− 2.59	0.4678
−228.24	0.07733	−178.57	0.1668	−110.51	0.2465	+ 7.40	0.4886
−223.97	0.08687	−169.90	0.1779	−101.47	0.2543	12.85	0.4956
−217.34	0.1015	−161.62	0.1894	− 92.30	0.2655		

Heat of melting	−47°3 36.00 cal 15°/g	KELLEY (1929)

HOVORKA, LANKELMA and STANFORD (1938); HOVORKA, LANKELMA and AXEBROD (1940); HOVORKA, LANKEMA and SMITH (1940); HOVORKA, LANKELMA and BISHOP (1941), have studied different hexylic alcohols.

3-METHYL-PENTANOL-3	$CH_3 . CH_2 . C(CH_3)OH . CH_2 . CH_3$
2,3-DIMETHYL-BUTANOL-2	$CH_3 . C(CH_3)OH . CH(CH_3) . CH_3$

Boiling and freezing points, density and refractive index: see HOWARD, MEARS, FOOKSON, POMERANTZ and BROOKS (1947).

n-HEPTYL ALCOHOL n-$C_7H_{15}OH$

Prepared by catalytic hydrogenation of oenanthol. The values of BILTERYS (1935), DEFFET (1931) and SHERRILL (1930), although close, do not agree.

THE HIGHER ALCOHOLS AND THEIR ISOMERS

EYKMAN in his „*Refractometrical Researches*" has determined a series of constants: boiling point under reduced pressure and freezing point, density and refractive index (for eight different wave-lengths) at one temperature; he did this for a great number of these alcohols. The samples appear to have been pure, but the information which the author has left is insufficient and there can be no absolute certainty as to the accuracy of his constants.

PICKARD and KENYON (1907–11) have prepared a series of optically active secondary alcohols. Their samples appear to have been carefully purified. Other authors e.g. LOWRY and RICHARDS (1924), have used the same sample of secondary octyl alcohol (methylhexyl carbinol). SMITH (1914) has repeated the preparation, but he obtained different results. Moreover the results given by BINGHAM and DARRAL (1930) also disagree with the others.

Recently, PATTERSON and HOLMES (1936) carefully studied the octyl alcohols. In the paper by BINGHAM and DARRAL, there is a series of constants concerning the isomers but, once again, there are insufficient indications of the degree of purity of the samples.

For *n*-octyl alcohol and methyl-hexyl carbinol, where comparison data exist, there are discrepancies. The same remarks hold for the values of the viscosities given by BINGHAM and STEPHENS (1933) for a series of higher isomeric alcohols.

n-OCTYL ALCOHOL n-$C_8H_{17}OH$

DEFFET (1931) obtained his sample by GRIGNARD's synthesis using *n*-heptyl iodide and formaldehyde.

Constants

Boiling point		*Freezing point*	
195°2	LECAT (passim)	−16°7	TIMMERMANS
194°45	DEFFET (1931)		

Density *Viscosity*

t°	d		t°	$\eta \cdot 10^5$	
0	0.84216	DEFFET (1931)	15	10640	DEFFET (1931)
15	0.83202	„	30	6125	„
30	0.82192	„			

Surface tension

t°	γ	
15	26.50	HENNAUT-ROLAND and LEK (1931)
20	26.06	„
30	25.21	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ	
15	1.42948	1.42983	1.43230	1.43670	1.43772	1.44096	1.44198	DEFFET (1931)
$\frac{dn}{dt}$	0.00040	40	40	41	40	41	41	„

DI-*iso*-BUTYLCARBINOL $[(CH_3)_2CH.CH_2]_2CHOH$: STROSS, GABLE and ROUNDS (1947).
Other alcohols in C_9 and C_{10}: HOWARD, MEARS, FOOKSON, POMERANTZ and BROOKS (1947).
Tertiary alcohols from C_8 to C_{14}: QUAYLE and SMART (1944).
DOROUGH, GLASS, GRESHAM, MALONE and REID (1941) have studied a series of methyloctanols (B.P.; d, n, heat of vap.).

n-HEXADECYLALCOHOL or CETYL ALCOHOL *n*-$C_{16}H_{33}OH$

Prepared by WÜRTZ's reaction using pure cetyl iodide.

It is then purified by fractional crystallization, first in glacial acetic acid to eliminate the iodide, then in carbon tetrachloride. The constancy of the melting point for successive fractions is the best criterion of purity.

Constants

Melting point

49°10	DELCOURT (1931)	49°22—49°27	CAREY and SMITH (1933)
49°10	FISCHER (1939)	49°27	SMITH (1931)

Melting curve: Deffet (1935) *Transition curve:* Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²
49.10	1	44.05	1
52.00	126	45.00	48.5
55.00	254	48.10	214
60.00	470	52.00	430
65.00	691	55.00	585
70.00	925	60.00	847
72.00	1014	61.50	932

Density *Viscosity*

t°	d		t°	$\eta \cdot 10^3$	
55	0.81521	Delcourt (1931)	50	134	Delcourt (1931)
75	0.80157	„	60	84.2	„
100	0.78395	„	75	53.8	„
79.7	0.7984	Eykman (1893)			

Refractive index: 79°7 Hα 1.42614 Hβ 1.43353 Eykman (1893)

Heat of combustion	20° (c_v) 10302.7 cal 15°/g 25° (c_v) 10302.7 „	Beckers (1931) Richardson and Parks (1939)

ALLYL ALCOHOL $CH_2{=}CH.CH_2OH$

This product is dried by fractional distillation over lime. The criterion of purity is the constancy of the density or of the critical solution point in paraffin oil. Water can also be eliminated as a constant boiling mixture (88°2), or as a ternary azeotrope with benzene. (Atkins and Wallace, 1912–13).

Constants: B.E. (1932)

Saturated vapour pressure: Ewert (1936)

t°	p mm	t°	p mm	
21.0	22.8	35.0	47.1	
25.0	28.1	40.0	61.2	
30.0	36.3			

Boiling point

96°85	$\frac{dt}{dp}$ *(10 mm):* 0°38 Lecat (passim)
97°0	„ 0°40 B.E. (1932)
97°06	Wallace and Atkins (1912) and Atkins and Wallace (1913)
97°08	Ewert (1936)

Density

t°	d		t°	d	
0	0.86814	B.E. (1932)	30	0.84209	B.E. (1932)
15	0.85511	„	0	0.86795	EWERT (1936)

Viscosity

t°	$\eta \cdot 10^5$	
15	1486	B.E. (1932)
30	1072	„

Surface tension

t°	γ	
15	26.15	B.E. (1932)
20	25.68	„
30	24.92	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	
15	1.41118	1.41175	1.41452	1.41982	1.42141	1.42545	B.E. (1932)
$\frac{dn}{dt}$	0.00041	41	41	40	42	45	„
20	1.40911	—	1.41246	1.41778	—	1.42322	EWERT (1936)

KENYON and SNELLGROVE (1925) have studied the following alcohols; their values seem to be reliable, but there are no data for comparison.

d-Methylvinyl carbinol	CH_3—CHOH—CH=CH_2
l-Ethylvinyl „	C_2H_5—CHOH—CH=CH_2
n-Propylvinyl „	C_3H_7—CHOH—CH=CH_2
n-Butylvinyl „	C_4H_9—CHOH—CH=CH_2

THE POLYALCOHOLS

VAN VOORST (1928) studied a series of glycols (density and refractive indices) from ethylene glycol up to tetradecyl glycol. This work appears to have been done well, but, for ethylene glycol, there are discrepancies with the values given by other authors.

ETHYLENE GLYCOL $(CH_2OH)_2$

Constants: B.E. (1935)

Saturated vapour pressure

t°	p mm		t°	p mm	
186.5	544.3	DE FORCRAND (1901)	117	29	BOESEKEN and HERMANS (1923)
173.2	357.3	„			
140.8	101	„	101	12	KAILAN and MELKUS (1927)
136.7	83	„			
122.5	44	„			

Boiling point			*Freezing point*	
197°4	$\frac{dt}{dp}$ *(10 mm):*	0°50 Lecat (passim)	−12°6	B.E. (1935)
197°85	„	0°50 B.E. (1935)		

Density

t°	d		t°	d	
0	1.12763	B.E. (1935)	0	1.12760	Ewert (1937)
15	1.11710	„	15	1.1170	Moureu and Dode (1937)
30	1.10664	„	17.8	1.1149	Eykman (1919)
0	1.1274	Walden (1906)	25	1.11005	Kailan and Melkus (1927)
25	1.1099	„	25	1.10986	Gibson and Kincaid (1937)
			25	1.10987	Gibson and Loeffler (1941)

Viscosity

t°	$\eta \cdot 10^4$	
15	2609	B.E. (1935)
30	1335	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.43056	1.43092	1.43312	1.43328	1.43732	1.43831	1.44146	B.E. (1935)
$\frac{dn}{dt}$	0.00026	26	—	26	27	27	27	„
16	—	—	1.4329	—	—	—	—	Moureu and Dode (1937)
15	1.43058	—	—	1.43320	1.43730	—	1.44141	Ewert (1937)
25	—	—	1.43063	—	—	—	—	Walden (1907)

Heat of combustion	25°, (c_v) 4578.2 cal 15°/g	Parks, West, Naylor, Fujii and McClaine (1946) (M.W. 62.068)

GLYCEROL $CH_2OH.CHOH.CH_2OH$

Impure glycerol contains metallic salts and must be distilled in a good vacuum to avoid decomposition; after this treatment, it can easily be dehydrated and purified by fractional distillation under ordinary pressure.

Glycerol is now commercially available in a fairly pure state.

The criteria of purity are the constancy of the density and of the critical solution point in *iso*amyl alcohol.

Constants: B.E. (1935). — **Polyphasic equilibria**

Saturated vapour pressure: Richardson (1886)

t°	p mm	t°	p mm	t°	p mm
139.04	2.338	183.25	20.461	220.3	100.813
141.04	2.588	183.40	20.512	224.3	115.25
143.645	3.046	192.0	30.62	227.0	130.535
145.555	3.285	193.30	34.369	229.5	137.95
147.06	3.385	199.8	41.81	237.1	183.503
151.99	4.083	200.8	44.865	241.80	201.225
162.45	8.115	201.3	45.61	246.4	239.95
169.70	12.059	205.8	52.767	248.5	258.627
171.05	12.694	211.5	65.61	257.3	347.092
175.52	15.683	217.3	86.725	260.4	385.326

Boiling point

290°0	Lewis (1922)
290°5	Lecat (passim)
290°6	Mac Ewen (1923)

Melting point

17°9	Gibson and Giauque (1923)
18°18	Albright (1937)
18°2	Louguinine (1880)
18°6	Volmer and Marder (1931)

Constants of state

Density

t°	d		t°	d	
15	1.26443	B.E. (1935)	15	1.2644	Schoorl (1922)
20	1.26134	„	20	1.2613	„
30	1.25512	„			
			13.2	1.2651	Patterson (1901)
20	1.2613	Winther (1907)	30	1.2552	„
30	1.2552	„	54.0	1.2397	„
40	1.2490	„	75.5	1.2256	„
50	1.2423	„	99.5	1.2097	„
60	1.2359	„	15	1.26415	Bosart (1939) (priv. comm.)
15	1.2641	Doulizkaya (1945)	20	1.2613	Albright (1937)

Viscosity

t°	η	
15	22.67	B.E. (1935)
30	5.87	„

Refractive index

t°	He r.	Hα	D	He y.	He v.	Hβ	He v.	
15	1.47275	1.47319	1.47547	1.47563	1.48009	1.48126	1.48450	B.E. (1935)
$\frac{dn}{dt}$	0.00022	22	—	22	22	23	23	„

Heat constants

Oblad and Newton (1937) give the heat content of anhydrous glycerol between −106°26 and +19°44.

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −203.26	0.1087	−180.56	0.1374	− 89.66	0.2290	Gibson and Giauque
−202.86	0.1091	−179.26	0.1399	−79.46	0.2390	„ (1923)
−201.86	0.1106	−175.06	0.1453	−57.56	0.2599	„
−197.06	0.1159	−168.46	0.1524	−55.06	0.2618	„
−192.46	0.1223	−157.46	0.1632	−46.46	0.2622	„
−191.76	0.1234	−145.36	0.1742	−27.86	0.2922	„
−190.06	0.1249	−135.06	0.1846	−23.86	0.2944	„
−187.36	0.1289	−124.46	0.1945	−13.46	0.3095	„
−187.16	0.1291	−111.36	0.2081	− 3.26	0.3232	„
−184.46	0.1321	− 99.56	0.2193			„
C. −270.08	0.000055	−258.58	0.00683	−218.59	0.0784	Ahlberg, Blanchard
−269.30	0.00010	−255.71	0.0107	−212.16	0.0883	and Lundberg (1937)
−268.13	0.000209	−253.62	0.0139	−206.35	0.0991	„
−266.86	0.000450	−251.27	0.0176	−200.82	0.1071	„
−265.72	0.00076	−247.91	0.0238	−195.71	0.1153	„
−264.65	0.00126	−243.61	0.0313	−190.83	0.1218	„
−263.50	0.00187	−237.80	0.0415	−186.24	0.1292	„
−262.18	0.00288	−230.20	0.0561			„
−260.69	0.00449	−223.97	0.0686			„

Heat of melting	17°9 47.50 cal 15°/g 47.95 „	Gibson and Giauque (1923) Volmer and Marder (1931)

ERYTHRITOL $CH_2OH.(CHOH)_2.CH_2OH$

Constants

Melting point: 118°9 Parks and Anderson (1926)

Specific heat: Parks and Anderson (1926)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −186.1	0.110	−173.5	0.124	− 87.1	0.212	2.3	0.300
−180.8	0.116	−171.9	0.127	− 79.6	0.219	15.9	0.315
−178.4	0.119	−167.5	0.131	− 72.6	0.227	18.6	0.317
−174.1	0.124	−161.4	0.137	+ 2.2	0.300		

Heat of combustion	25°, (c_v) 4096.0 cal 15°/g	Parks, West, Naylor, Fujii and Mc Claine (1946) (M.W. 122.120)

MANNITOL $CH_2OH.(CHOH)_4.CH_2OH$

Constants

Melting point

165°98 166°	Burriel-Marti (1930) Krafft and Dijes (1895)	166° 166°0	Pearce and Snow (1927) Parks and Anderson (1926)

Specific heat: Parks and Anderson (1926)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −184.6	0.107	−165.8	0.127	−120.1	0.171	−71.5	0.218
−178.7	0.113	−164.9	0.128	−112.8	0.178	+ 1.9	0.290
−177.2	0.115	−162.0	0.131	− 79.9	0.209	16.9	0.307
−171.1	0.121	−154.8	0.137	− 75.1	0.214	21.0	0.310

Heat of combustion	25°, (c_v) 3969.5 cal 15°/g	Parks, West, Naylor, Fujii and Mc Claine (1946) (M.W. 182.172)

B. ETHERS and ACETALS

DIMETHYL ETHER $(CH_3)_2 O$

This gas is prepared by heating a mixture of methanol and concentrated sulphuric acid. At 80°—85° dimethylether is evolved and is separated from carbon dioxide and moisture by passing over caustic potash, lime and phosphorus pentoxide. It is then fractionated at low temperature (Leduc's method, 1898)

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. atm.	d cr.	
126°90	52.0	—	Cardoso and Bruno (1923)
127°1	53.0	—	Briner and Cardoso (1908), Briner (1907), Guye and Briner (1909)
—	—	0.2714	Cardoso and Coppola (1923)

Densities of the liquid and the saturated vapour

t°	L.	V.	t°	L.	V.	
126.50	0.3098	0.2337	110.50	0.4550	0.1076	Cardoso and Coppola
126.01	0.3293	0.2139	96.52	0.5042	0.0754	,, (1923)
125.01	0.3518	0.1932	80.15	0.5522	0.0486	,,
124.19	0.3646	0.1812	56.05	0.6012	0.0290	,,
121.12	0.3950	0.1548	29.85	0.6458	0.0160	,,
115.90	0.4308	0.1258	0.20	0.6903	0.0042	,,

Saturated vapour pressure: Kennedy, Sagenkahn and Aston (1941)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
−101.53	4.97	−78.23	35.13	−55.15	164.34	−35.11	475.55
− 95.45	8.46	−70.67	60.91	−49.91	221.71	−31.19	571.59
− 94.95	8.82	−65.26	87.80	−45.11	287.53	−27.68	670.27
− 89.75	13.80	−60.04	122.37	−40.03	373.61	−24.92	756.42

Cardoso and Bruno (1923)

t°	p atm.	t°	p atm.	t°	p atm.	t°	p atm.
126.90	52.00	112.80	40.43	64.68	15.95	25.40	6.05
125.90	51.00	110.57	38.82	56.02	13.11	23.75	5.64
122.20	47.67	99.90	32.14	49.75	11.22	16.80	4.58
117.80	44.06	99.20	31.75	48.50	10.91	9.25	3.58
116.82	43.41	90.25	26.80	46.13	10.31	0.00	2.52
113.75	41.24	80.10	22.14	33.55	7.49		

Boiling point

−24°82	Kennedy, Sagenkahn and Aston (1941)
−24°9	Maass and Boomer (1922)
−24°9	Grosse (1937)

Melting point

−141°50	Kennedy, Sagenkahn and Aston (1941)

Constants of state

Weight of the gas: (normal litre) 2.1097 Batuecas (1924)
(at 25° and 1 atm.) 1.91855 ± 0.00012 Kennedy, Sagenkahn and Aston (1941)

Coefficient of dilatation of the gas: (11°03 → 48°01) $3920 \cdot 10^{-6}/760$ mm Coppok and Whytlaw—Gray (1934)

Deviation from Avogadro's law: A_0^1: = 1.0270 Batuecas (1924)

Viscosity: Van Cleave and Maass (1935)

t°	$\eta \cdot 10^7$	t°	$\eta \cdot 10^7$	t°	$\eta \cdot 10^7$	t°	$\eta \cdot 10^7$
−56.91	658.4	−23.39	755.2	−0.13	824.7	18.11	883.0
−41.16	703.0	− 8.67	797.4	11.71	862.4	22.90	899.4

Heat constants

Specific heat: Kennedy, Sagenkahn and Aston (1941) (M.W. 46.069)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
−259.46	0.0169	−216.68	0.1852	−151.04	0.3386	−86.98	0.5141
−257.17	0.02528	−213.16	0.1946	−145.41	0.3500	−82.29	0.5145
−254.47	0.03722	−211.29	0.2014	−143.85	0.3777	−76.86	0.5151
−252.01	0.04901	−199.02	0.2342	−135.98	0.5091	−72.53	0.5161
−248.89	0.06304	−193.48	0.2482	−130.46	0.5097	−67.57	0.5173
−244.96	0.07990	−187.82	0.2607	−124.59	0.5099	−62.65	0.5184
−240.80	0.09909	−181.87	0.2740	−124.41	0.5101	−55.20	0.5195
−236.98	0.1151	−176.23	0.2861	−110.24	0.5104	−49.87	0.5212
−233.67	0.1287	−170.46	0.2993	−108.24	0.5108	−44.43	0.5236
−230.14	0.1410	−164.45	0.3124	−100.21	0.5114	−38.83	0.5243
−225.18	0.1588	−156.71	0.3280	− 94.19	0.5125	−27.68	0.5351
−219.28	0.1771						

Heat of vaporisation	−24°80 111.64 cal 15°/g	Kennedy, Sagenkahn and Aston
Heat of melting	25.621 „	„ (1941)

DIETHYL ETHER $(C_2H_5)_2O$

Strange though it may seem, the constants of ether are not yet accurately known, despite the great number of studies that have been made of it.

A general survey of the old research material (up to 1903) concerning the properties of ether, notably the density, may be found in one of BEIN's memoirs (1908).

The works of WADE and FINNEMORE (1909) and CLARKE (1924) are generally considered as careful. The works of ROWE (1924) and ROWE and PHELPS (1924) concerning the impurities of ether for anesthesia and the work of PERKINS (1917) are also interesting; a general survey of the constants of pure ether has been published by BASKERVILLE and HAMOR (1911). The research concerning the impurities in ether by MIDDLETON and HYMAS (1931) may also be mentioned.

In order to obtain ether having invariable properties, ordinary ether is first distilled to get rid of the head fraction; it is then directly distilled over sulphuric acid and allowed to stand over sodium or P_2O_5 for a prolonged period.

Finally it is fractionated in the absence of moisture. The chemical treatment is necessary because ether forms an azeotrope with 1,3 % water distilling at 34°15; it cannot be separated by mere distillation: neither can ethyl alcohol be removed by physical means, although it does not give an azeotrope with ether (WADE and FINNEMORE). The ethyl alcohol is also retained by P_2O_5. Attaining the fifth degree of purity ($\Delta t = 0°000$) with the ebulliometer of SWIETOSLAWSKI offers no difficulty. Pure ether must be kept in vacuo, in sealed tubes and in the dark.

A general experimental and critical work, concerning the principal constants of ether, was published by B.E. (1928); a study of the impurities, their quantitative determination and the purification of ether, by GILLO (1938); the quantitative determination of water in ether, by GASPART and SERRURE (1939). According to GILLO, small amounts of ether peroxide (10^{-4} %) can be detected by iodometry; and of aldehyde, by decolorised fuchsin. GILLO eliminated traces of aldehydes, alcohols and unsaturated compounds by permanganate oxidation; acids were neutralized and the ether then submitted to the previously described treatment.

Constants: B.E. (1928). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
193°6	—	—	DE VRIES (1895)
193°61	27565	0.2665	WILIP (1924)
193°62	—	—	TRAVERS and USHER (1906)
193°8	27060	0.2625	YOUNG (1910)
193°9	27436	—	SCHEFFER (1913) and PRINS (1915)

Influence of small quantities of water: PAUL and SCHANTZ (1919)

Densities of the liquid and the saturated vapour: Young (1910)

t°	L.	V.	t°	L.	V.	t°	L.	V.
0	0.7362	0.000827	80	0.6402	0.01155	160	0.4947	0.06911
10	0.7248	0.001264	90	0.6250	0.01477	170	0.4658	0.08731
20	0.7135	0.001870	100	0.6105	0.01867	180	0.4268	0.1135
30	0.7019	0.002677	110	0.5942	0.02349	185	0.4018	0.1320
40	0.6894	0.003731	120	0.5764	0.02934	190	0.3663	0.1620
50	0.6764	0.005079	130	0.5580	0.03638	192	0.3448	0.1826
60	0.6658	0.006771	140	0.5385	0.04488	193	0.3300	0.2012
70	0.6532	0.00892	150	0.5179	0.05551			

Rectilinear diameter: $0.3685 - 5377 \cdot 10^{-7}\, t^\circ - 475 \cdot 10^{-10}\, t^{\circ 2}$ Young (1910)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−101.3	0.058	−93.4	0.150	−81.0	0.584	Mündel (1913)
− 96.7	0.096	−88.1	0.270	−78.5	0.762	"
− 95.2	0.118	−83.5	0.443	−76.2	0.949	"
−60.799	3.95	−31.329	34.03	+0.009	186.13	Taylor and Smith (1922)
−55.748	5.93	−26.421	45.81	4.975	233.73	"
−50.873	8.77	−21.502	61.31	9.937	290.62	"
−45.998	12.62	−16.578	80.67	14.903	358.15	"
−41.125	17.78	−11.637	104.79	19.871	437.70	"
−36.231	24.77	− 6.698	134.76			"
−10	112.3	80	2974	160	15778	Young (1910)
0	184.9	90	3831	170	18671	"
10	290.8	100	4855	180	21775	"
20	439.8	110	6082	185	23623	"
40	921.0	120	7513	190	25513	"
50	1276	130	9155	192	26331	"
60	1734	140	11051	193	26800	"
70	2304	150	13262	193.8	27060	"
0.0	185.3	20.0	442.2	40.0	921.8	Louder, Briggs and Brown (1924)
5.0	233.2	25.0	537.0	45.0	1089.8	
10.0	291.7	30.0	647.3	50.0	1276.4	"
15.0	360.7	35.0	775.5			"
15.5	364.2	20.5	447.1			Joukovsky (1934)
18.0	404.3	22.8	490.3			"
19.3	427.1	24.3	521.8			"
20	440	30	646.8			Schulze (1921)
156.9	15200	171.1	19228	185.3	24092	Scheffer (1913)
160.9	16302	177.3	21204	190.5	25992	"
165.5	18240	180.8	22458	193.9	27436	"

Isotherms: Beattie (1924), Jönsson (1887—88) and Keyes and Felsing (1919)

Boiling point

34°40	Marshall (1906)	34°6	Perkin (1884)
34°47	Clarke (1924)	34°6	Richardson (1891)
34°481	Wojciechowski (1936)	34°60	Tyrer (1914)
34°50	Wade and Finnemore (1909)	34°60	B.E. (1928) and Lecat (passim)
34°50	Mündel (1913)	34°60	Young (1910)
34°54	Grimm and Patrick (1923)	34°600	Lalande (1934)
34°58	Morino (1933)		

$\frac{dt}{dp}$ *(10 mm)*

0°36	B.E. (1928) and Lecat (passim)	0°372	Wojciechowsky (1936)

Melting point

Stable form:		*Metastable form:*	
—116°3	Timmermans, Van der Horst and Kamerlingh Onnes (1922)	−123°3	Timmermans (1912)
		−123°3	Mac Neight and Smyth (1936)
−116°3	Parks and Huffman (1926)	−123°4	Parks and Huffman (1926)
−116°3	Mac Neight and Smyth (1936)	−123°40	Keyes, Townshend and Young (1922)

Constants of state

Density

The discrepancies shown in the results of several creditable authors indicate once more the difficulty of securing perfectly reliable values for measurements at different temperatures.

t°	d	t°	d	t°	d	
15.4	0.71886	−37.2	0.77707	— 94.5	0.83679	Timmermans (1912)
0	0.73627	−45.0	0.78540	−104.85	0.84696	„
— 6.2	0.74285	−53.6	0.79459	−111.6	0.85365	„
—13.1	0.75092	−63.3	0.80440	−116.2	0.85844	„
—22.95	0.76132	−73.95	0.81500	−123.3	0.86538	„
—30.6	0.76994	−74.25	0.81554			„
—35.3	0.77520	−83.4	0.82519			„

Density (continued)

t°	d	t°	d	t°	d	
70	0.65226	5	0.73069	− 60	0.80084	Taylor and Smith (1922)
65	0.65866	0	0.73629	− 65	0.80606	,,
60	0.66501	− 5	0.74180	− 70	0.81126	,,
55	0.67129	−10	0.74729	− 75	0.81643	,,
50	0.67751	−15	0.75275	− 80	0.82159	,,
45	0.68367	−20	0.75819	− 85	0.82672	,,
40	0.68976	−25	0.76360	− 90	0.83182	,,
35	0.69580	−30	0.76899	− 95	0.83690	,,
30	0.70177	−35	0.77436	−100	0.84196	,,
25	0.70768	−40	0.77970	−105	0.84699	,,
20	0.71352	−45	0.78502	−110	0.85200	,,
15	0.71930	−50	0.79032	−115	0.85699	,,
10	0.72503	−55	0.79559	−120	0.86195	,,

t°	d		t°	d	
0	0.73622	B.E (1928)	0	0.7362	Young (1910)
15	0.71925	,,	10	0.7248	,,
30	0.70205	,,	20	0.7135	,,
			30	0.7019	,,
			40	0.6894	,,
15	0.71930	Wade and Finnemore (1909)	20	0.7135	Schulze (1912)
20	0.7134	Stearn and Smith (1934)	20	0.7135	Deutschmann (1911)
20	0.7135	Lowry (1914)	25	0.70778	Lalande (1934)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0	279	B.E. (1928)	0	288	Sachanov and Rjachovsky
15	247	,,	25	224	,, (1914)
			20	234.5	Dolezalek and Schulze (1913)

Surface tension

t°	γ		t°	γ	
15	17.62	Hennaut-Roland and Lek	20	17.04	Desreux (1935)
20	17.06	,, (1931)	20	17.01	(vacuum) Richards and Carver (1921)
30	15.95	,,			
			20	16.96	(no vacuum) Richards and Carver (1921)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.35341	1.35381	1.35555	1.35557	1.35910	1.36005	1.36263	1.36375	B.E. (1928)
$\frac{dn}{dt}$	0.00055	56	56	56	56	56	56	58	„
12.6	—	—	—	1.35691	—	—	—	—	Joukovsky (1934)

Dielectric constant

t°	ε		t°	ε	
−40	5.910	Le Fevre (1938)	0	4.803	Le Fevre (1938)
−30	5.600	„	10	4.575	„
−20	5.325	„	20	4.376	„
−10	5.066	„	25	4.265	„
			30	4.152	„

Specific magnetic susceptibility: 20° −0.60 Henrichsen (1888)

Molecular magnetic rotatory power: 20° 4.777 Perkin (1884)

20° 4.84 Lowry (1914)

Heat constants

Specific heat: Parks and Huffman (1926)

t°	c_p	t°	c_p	t°	c_p
C. −197.06	0.201	−175.86	0.236	−158.66	0.259
−190.66	0.212	−169.46	0.244	−149.86	0.271
−184.06	0.222	−162.66	0.254	−142.06	0.283
−179.76	0.227	−162.36	0.255	−137.96	0.287
−176.46	0.233	−161.16	0.256		
L. −108.76	0.475	−67.66	0.505	7.04	0.547
− 87.06	0.490	−59.66	0.507	12.84	0.549
− 77.56	0.498	+ 2.04	0.544	16.84	0.551
− 71.56	0.501				

Heat of vaporisation cal 15°/g

10°	92.37	Leduc (1917)
30°	89.80	„
50°	86.93	„

DI-*n*-PROPYL ETHER $(n\text{-}C_3H_7)_2O$

Constants: B.E. (1930)

Saturated vapour pressure: BINGHAM (1910)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
8.80	29.9	33.01	95.4	66.30	356.2	81.80	598.0
11.95	34.2	41.60	134.1	70.01	404.1	83.19	625.0
18.40	47.3	45.23	155.0	71.99	432.6	84.75	654.6
21.42	55.4	49.52	184.9	73.60	456.6	86.10	682.4
24.05	62.1	57.50	255.1	77.40	517.6	86.89	701.4
27.61	73.7	59.70	278.4	79.00	546.9	88.78	741.1
28.71	76.9	62.47	309.8	80.40	572.1		

Boiling point

90°05	WUYTS and LACOURT (1930)
90°1	$\frac{dt}{dp}$ *(10 mm):* 0°47 (1930) and LECAT (passim)

Density

t°	d	
0	0.76611	B.E. (1930)
15	0.75178	„
30	0.73737	„

Surface tension

t°	γ	
15	21.12	B.E. (1930)
20	20.53	„
30	19.35	„

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0.59	535.9	THORPE and RODGER	56.15	287.7	THORPE and RODGER
8.58	482.6	„	64.16	266.4	„ (1897)
16.95	435.8	„ (1897)	72.59	246.9	„
24.65	398.5	„	81.47	228.4	„
32.46	365.5	„	88.02	215.4	„
40.47	336.0	„	15	448	B.E. (1930)
48.06	311.4	„	30	376	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.38049	1.38090	1.38296	1.38673	1.38759	1.39062	1.39169
$\frac{dn}{dt}$	0.00049	49	49	50	50	53	51

DI-*iso*-PROPYL ETHER $[(CH_3)_2CH]_2O$

Saturated vapour pressure, boiling point, density, viscosity, surface tension, refractive index and *heat of vaporisation:* Fife and Reid (1930). *Boiling point, density, refractive index:* Snyder and Gilbert (1942). *Boiling point:* Lecat (passim); *freezing point:* Timmermans (passim) and Parks (1925). The values of Fife and Reid (1930) and of Snyder and Gilbert (1942) do not agree.

DI-*n*-BUTYL ETHER $(n\text{-}C_4H_9)_2O$

Constants: B.E. (1930)

Saturated vapour pressure: Hill and Fitzgerald (1935)

t°	p mm	t°	p mm	t°	p mm
11.3	7.5	19.7	10.5	25.9	12.7
15.4	9.0	25.0	12.5	29.7	14.5

Boiling point

142°4	$\frac{dt}{dp}$ *(10 mm):* 0°50 Lecat (passim)
142°4	Popelier (1923)
142°40	0°50 B.E. (1930)

Freezing point: −97°9 Timmermans (passim)

Density

t°	d
0	0.78536
15	0.77254
30	0.75976

Viscosity

t°	$\eta \cdot 10^5$
15	741
30	602

Surface tension

t°	γ
15	23.40
20	22.93
30	21.99

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ
15	1.39665	1.39698	1.39906	1.40297	1.40393
$\frac{dn}{dt}$	0.00043	45	45	45	45

DI-*n*-AMYL ETHER $(n\text{-}C_5H_{11})_2O$

This compound can only be obtained in a pure state from synthetic *n*-amyl alcohol.

Constants: B.E. (1928)

Boiling point: 187°50 $\frac{dt}{dp}$ *(10 mm):* 0°57 B.E. (1928) and Lecat (passim)

Freezing point: −69°3

Density *Viscosity*

t°	d		t°	$\eta \cdot 10^5$	
0	0.79881	B.E. (1928)	15	1188	B.E. (1928)
15	0.78695	„	30	922	„
30	0.77505	„			

Surface tension

t°	γ	
15	25.25	Hennaut-Roland and Lek (1931)
20	24.76	„
30	23.78	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.
15	1.41159	1.41167	1.41392	1.41423	1.41834	1.41902	1.42313
$\frac{dn}{dt}$	0.00042	42	42	42	42	42	42

METHYL-ETHYL ETHER $CH_3.O.C_2H_5$

Mixed ethers are prepared by the action of the alkyl iodide on the sodium alcoholate in alcoholic solution.

Constants: Berthoud and Brum (1924)

Critical constants

t° cr.	d cr.	
164°7	0.2722	

Densities of the liquid and the saturated vapour

t°	L.	V.	t°	L.	V.
0	0.7260	0.0024	138.4	0.4927	0.0791
78.3	0.6142	0.0233	145.2	0.4690	0.0953
94.5	0.5883	0.0311	150.2	0.4488	0.1116
119.3	0.5406	0.0521	154.5	0.4306	0.1251
130.0	0.5160	0.0654	158.2	0.4136	0.1406

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm
0	560	50	3192	90	8740	130	19000
10	841	60	4256	100	10792	140	22496
20	1222	70	5472	110	13148	150	26524
30	1732	80	6992	120	15960	160	30856
40	2385						

Boiling point: 7°6

Density *Surface tension*

t°	d	t°	d	t°	γ	
0	0.7260	32.3	0.6825	7.9	17.54	Berthoud and Brum (1924)
13.6	0.7062	41.9	0.6701	33.5	14.10	,,
21.1	0.6973	50.7	0.6570	45.5	12.60	,,

METHYL-*n*-PROPYL ETHER $CH_3.O.n\text{-}C_3H_7$

Constants

Saturated vapour pressure: Bingham (1910)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
−0.60	151.8	18.67	352.6	28.25	517.6	33.80	633.9
+3.42	180.0	20.02	376.0	29.00	533.4	34.84	658.1
7.01	212.6	21.01	388.3	30.12	555.9	35.58	675.2
8.81	230.9	23.00	420.5	31.01	574.5	36.73	703.8
12.58	272.2	23.91	436.0	31.87	594.0	38.34	739.5
14.30	293.3	24.85	453.3	32.72	612.5	39.34	765.6
17.60	336.9	26.80	487.5				

Boiling point

38°9	Dobriner (1888)	39°14	Bingham (1910)
38°95	Lecat (passim)	39°15	Thorpe and Rodger (1897)

Density

0°	0.7470	Dobriner (1888)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0.30	306.4	Thorpe and Rodger	20.10	251.3	Thorpe and Rodger
5.14	291.4	„ (1897)	25.73	238.5	„ (1897)
10.47	275.4	„	29.48	230.0	„
15.17	263.0	„	35.15	218.7	„

ETHYL-*n*-PROPYL ETHER $C_2H_5.O.n\text{-}C_3H_7$

Critical constants, saturated vapour pressure, boiling point, density and *surface tension;* Berthoud and Brum (1924). *Saturated vapour pressure:* Bingham (1910). *Viscosity;* Thorpe and Rodger (1897). *Freezing point, heat of vaporisation:* Nagornow and Rotinjanz (1911). The values of Bingham (1910) and Berthoud and Brum (1924) do not agree with each other.

Kenyon and Mac Nicol (1923) studied different mixed *sec.* OCTYL ETHERS (from CH_3 up to C_9H_{19}). There are no comparison data for these compounds.

DIVINYL ETHER $(CH_2{=}CH)_2\,O$

Saturated vapour pressure and *density:* Miles and Menzies (1933).

DIMETHYLFORMAL or METHYLAL $CH_2(OCH_3)_2$

This substance forms with methanol an azeotrope, which cannot be eliminated by distillation alone: it boils only 0°25 lower than pure methylal. In order to eliminate methyl alcohol, it is thus necessary to distil the methylal repeatedly over metallic sodium, a process involving a considerable loss of material but leading to a pure product.

Constants: B.E. (1928)

Critical temperature: 215°2 Bourgom (1924)

Boiling point *Freezing point*

42°3	Bourgom (1924)	−105°0	B.E. (1928)
42°3	Ghysels (1924)		
42°30	$\frac{dt}{dp}$ *(10 mm):* 0.40 B.E. (1928) and Lecat (passim)		

Density

t°	d		t°	d	
0	0.88545	B.E. (1928)	0	0.88546	GHYSELS (1924)
15	0.86645	„	15	0.86657	„
30	0.84745	„	18.2	0.8621	BRÜHL (1897)

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
0	402	B.E. (1928)	15	21.79	HENNAUT-ROLAND and LEK (1931
15	340	„	20	21.12	„
30	325	„	30	19.76	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.35414	1.35430	1.35626	1.35636	1.35963	1.36014	1.36301	1.36356	B.E. (1928)
$\frac{dn}{dt}$	0.00048	48	49	49	50	50	52	52	„
16	—	1.35379	1.35553	—	—	1.35957	—	1.36290	BOURGOM (1924)
18.2	—	1.35229	1.35397	—	—	1.35801	—	1.36122	BRÜHL (1897)

Dielectric constant: 20° 3.485 PIETTE (1947)

DIETHYLFORMAL or ETHYLAL $CH_2(OC_2H_5)_2$

Constants: B.E. (1930)

Boiling point: 87°95 LECAT

88°00 $\frac{dt}{dp}$ *(10 mm):* 0°44

Freezing point: −66°5

Density *Viscosity* *Surface tension*

t°	d	t°	$\eta \cdot 10^5$		t°	γ	
0	0.85021	15	442	B.E. (1930)	15	21.71	HENNAUT-ROLAND and LEK (1931)
15	0.83465	30	344	„	20	21.18	
30	0.81896			„	30	20.13	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.37317	1.37358	1.37546	1.37893	1.37984	1.38252	1.38314
$\frac{dn}{dt}$	0.00046	47	46	46	47	44	—

Dielectric constant: 20° 2.885 PIETTE (1947)

DI-*n*-BUTYL ACETAL $CH_3.CH(O\ n\text{-}C_4H_9)_2$

Saturated vapour pressure: CONNER, ELVING and STEINGISER (1948)

C. ALDEHYDES

The aldehydes are very difficult to purify, as they are easily oxidised and polymerised. Formaldehyde is purified by sublimation and fractional freezing (TRAUTZ and UFER, 1926).

ACETALDEHYDE $CH_3.CHO$

This substance is relatively easy to purify by fractional distillation of a sample obtained by depolymerisation of very pure paraldehyde. The equilibria with paraldehyde were studied by HOLLMANN (1903), DE LEEUW (1910–11) and SMITS and DE LEEUW (1910).

Critical temperature and *boiling point:* HOLLMANN (1903); *saturated vapour pressure, density* and *refractive index:* DE LEEUW (1910–1911), SMITS and DE LEEUW (1910); *melting point:* SCHWAB and WICKERS (1944); *density:* PERKIN (1887); *density* and *viscosity:* FRIEND and HARGREAVES (1944); *density, specific heat* and *heat of vaporisation:* COLEMAN and DE VRIES (1949)

OENANTHAL or *n*-HEPTYL ALDEHYDE $n\text{-}C_6H_{13}.CHO$

Constants: Deffet (1931)

Boiling point: 152°8 $\frac{dt}{dp}$ *(10 mm):* 0°51

Freezing point: −43°3 Timmermans

Density

t°	d	
0	0.83423	Deffet (1931)
15	0.82162	„
30	0.80902	„

Viscosity

t°	$\eta \cdot 10^5$	
15	977	Deffet (1931)
30	791	„

Surface tension

t°	γ	
15	27.04	Hennaut-Roland and Lek (1931)
20	26.58	„
30	25.68	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.41247	1.41282	1.41511	1.41952	1.42044	1.42378	1.42471
$\frac{dn}{dt}$	0.00054	54	54	54	54	54	54

ACROLEIN or ACRYLIC ALDEHYDE $CH_2{=}CH.CHO$

Saturated vapour pressure, boiling point, density and *refractive index*: Moureu, Boutaric and Dufraisse (1920–21).

D. KETONES

ACETONE $CH_3.CO.CH_3$

The purification of acetone involves two distinct processes. The bisulphite compound is used in order to eliminate the impurities other than ketones; the compound with sodium iodide (Shipsey and Werner, 1913) may also be employed. The product has then to be dehydrated chemically, although no azetrope is formed with water; small amounts of water do not affect the vapour tension of acetone to an appreciable extent, so that dehydration is impossible even with a powerful dephlegmator.

As dehydrating agent, calcium chloride is ineffective and it is necessary to redistil over a small amount of P_2O_5; this process involves a great loss of material through condensation reactions (Timmermans, 1910–1912). According to Gillo (1938), it is possible to obtain a sample containing less than 0.0002 % of water by treating repeatedly with P_2O_5 and leading the vapour over this dehydrating agent.

Tests for impurities. (Gillo, 1938): small amounts of methyl alcohol (ebulliometry), of acetaldehyde (decolorised fuchsin), and acetic acid (titrimetry) are determined from $1 \rightarrow 5 \cdot 10^{-4}$ %. The presence of $2 \cdot 10^{-4}$ % of water may be indicated by infra-red spectrography (Gaspart and Gillo, 1938).

Anhydrous acetone must be kept in sealed tubes.

Constants: B.E. (1928). — **Polyphasic equilibria**

Saturated vapour pressure

t°	p mm		t°	p mm	
0.32	71.4	Roland (1928)	0	69.2	Schmidt (1926)
0.92	73.9	„	20	181.0	„
9.98	115.9	„	30	282.5	„
15.00	147.1	„	35	347.5	„
20.14	185.7	„	40	420.5	„
25	229.4	„	50	619	„
29.95	281.8	„			
35.106	355.1	Zmaczynski (1930)	66.623	1074.6	Zmaczynski (1930)
40.616	433.9	„	71.915	1268.1	„
45.758	525.76	„	77.235	1489.2	„
50.930	633.90	„	82.586	1741.0	„
56.131	760.00	„	87.967	2026.3	„
61.362	906.1	„	93.377	2347.4	„
28.15	258.8	Beckmann and Faust	20	179.6	Fischer and Zerbe (1923)
40.10	425.0	„ (1914)			
55.40	741.8	„			

Boiling point

56°1	Barr and Bircumshaw (1921)	56°20	B.E. (1928)
56°11	Clusius and Ringer (1940)	56°20	Rosanoff and Easley (1909)
56°13	Zmaczynski (1930)	56°20	Dutoit and Friederich (1900)
56°15	Grimm and Patrick (1923)	56°22	Mac Ewen (1923)
56°15	Lecat (passim)	56°25	Young (1933)
		56°3	Jones (1929)

$\frac{dt}{dp}$ *(10 mm)*

0°38 0°386	Crafts (1887) Zmaczynski (1930)	0°39	B.E. (1928) and Lecat (passim)

Freezing point

−94°82	Clusius and Ringer (1940)	−94°9	Mac Neight and Smyth (1936)

Constants of state

Density

t°	d		t°	d	
−94.5	0.91567	Timmermans (1912)	−37.2	0.85337	Timmermans (1912)
−83.4	0.90321	„	−30.6	0.84603	„
−73.95	0.89289	„	−22.95	0.83754	„
−63.3	0.88150	„	−13.1	0.82701	„
−53.6	0.87132	„	− 6.2	0.81943	„
−45.0	0.86198	„	0	0.81248	„
0	0.81250	B.E. (1928)	20	0.79082	Price (1919)
15	0.79597	„	30	0.77931	„
30	0.77933	„	40	0.76784	„
15	0.79574	Timmermans (1910)	50	0.75599	„
20	0.79053	Zmaczynski (1930)	20	0.79053	Young (1933)
20	0.79060	Grünert (1927)	25	0.78502	Barr and Bircumshaw (1921)
40	0.76820	„	25	0.78502	Lewis (1924)
0	0.81252	Richards and Shipley (1916)	25	0.78503	Hughes and Hartley (1933)
			25	0.7846	Albright (1937)

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
0	398	Lacher, Walden and Park (1949)	15	23.92	Hennaut-Roland and Lek (1931)
15	337.1	B.E. (1928)	20	23.32	„
30	295.4	„	30	22.01	„
25	307.5	Hughes and Hartley (1933)			

Refractive index

t°	Hα	D	He y.	Hβ	
15	1.35959	1.36157	1.36176	1.36634	B.E. (1928)
$\frac{dn}{dt}$	0.00049	50	50	50	„
17.5	1.35832	—	—	1.36515	Guillery (1930) (+ other values)
20	—	1.35911	—	—	Pahlavouni (1927)
25	—	1.35662	—	—	Rosanoff, Bacon and White (1914)

Magnetic rotatory power: 20° 3.50 Lowry (1914)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −203.5	0.219	−182.3	0.257	−168.8	0.278	Parks and Kelly
−198.9	0.229	−181.9	0.259	−167.8	0.281	„ (1925)
−193.4	0.239	−177.9	0.266	−121.9	0.350	„
−187.6	0.250	−173.0	0.272	−120.1	0.352	„
−76.5	0.480	+ 3.8	0.507	10.3	0.509	„
−73.0	0.482	6.2	0.508	16.3	0.513	„
−55.6	0.485					„
L. 23.54	0.519	34.65	0.527	46.30	0.536	Tréhin (1921)
28.03	0.518	38.26	0.527			„
32.07	0.526	42.71	0.529			„

Heat of vaporisation	(B.P) 125.3 cal 15°/g	Grimm and Patrick (1923)
Heat of melting	23.42 „	Parks and Kelley (1925)
Heat of combustion	25° (c_p) 7365.3 „	Miles and Herschel Hunt (1941) (M.W.: 58.0786)

DIETHYLKETONE $C_2H_5.CO.C_2H_5$

Constants: B.E. (1932)

Boiling point

102°00	$\frac{dt}{dp}$ *(10 mm):*	0°38	B.E. (1932)
102°05	„	0°38	Lecat (passim)
102°35			Eykman (1919)

Freezing point —39°9 B.E. (1932)

Density

t°	d		t°	d	
0	0.83353	B.E. (1932)	10	0.8243	Gross, Rintelen and
15	0.81907	„	30	0.8045	„ Saylor (1939)
30	0.80461	„	50	0.7867	„
24.80	0.8097	Owen, Quayle and Clegg	17.6	0.8163	Eykman (1919)
34.85	0.8000	„ (1942)	20	0.8141	Gartenmeister (1890)
50.15	0.7848	„			

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$	t°	γ		t°	γ	
15	493	15	25.87	B.E. (1932)	24.80	24.73	Owen, Quayle and Clegg
30	423	20	25.26	„	34.85	23.74	„ (1942)
		30	24.37	„	50.15	22.11	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ	
15	1.39242	1.39272	1.39496	1.39884	1.39983	1.40278	—	B.E. (1932)
$\frac{dn}{dt}$	0.00046	45	45	46	47	46	—	„
17.6	1.39148	1.39176	1.39383	1.39774	1.39871	1.40162	1.40277	Eykman (1919)

DI-*n*-PROPYLKETONE $(n\text{-}C_3H_7)_2CO$

Constants

Boiling point | *Freezing point*

143°52	$\frac{dt}{dp}$ *(10 mm)*: 0°48 LOUGUININE (1898)	—32°5	TIMMERMANS (passim)
143°55	LECAT (passim)		

Density

t°	d		t°	d	
14.8	0.8203	PERKIN (1896)	15.1	0.8205	EYKMAN (1893–1919)
90	0.7534	„	22	0.8160	ERRERA and SHERRILL (1930)

Viscosity: 20° $751 \cdot 10^{-5}$ GARTENMEISTER (1890)

Refractive index

t°	Hα	Hβ	
15°1	1.40818	1.41538	EYKMAN (1893)

Molecular magnetic rotatory power

15°	7.471	LOWRY (1914)	14°8	7.471	PERKIN (1896)
20°	7.44	„	90°0	7.377	„

DI-*n*-BUTYLKETONE has not been thoroughly studied.

DI-*iso*-BUTYLKETONE $(CH_3)_2.CH.CH_2.CO.CH_2.CH.(CH_3)_2$

Constants: Stross, Gable and Rounds (1947)

Saturated vapour pressure		*Boiling point*	*Freezing point*
t°	p mm		
86.41 103.54	50 100	168°24	−46°04

Density

t°	d
20.00	0.80600
40.00	0.78995
60.00	0.77379

Viscosity

t°	$\eta \cdot 10^5$
0	1320
20	930
30	765
40	665

Refractive index

t°	Hα	D	Hβ
20.00	1.41012	1.41225	1.41751

Heat of vaporisation	168°24 103°54 86°41	60.33 67.66 69.68	cal 15°/g „ „

DI-*n*-AMYLKETONE $(n\text{-}C_5H_{11})_2CO$

Constants: SIMON (1929)

Boiling point: 228°0 *Freezing point:* 14°6 TIMMERMANS (passim)

Density *Viscosity*

t°	d		t°	$\eta \cdot 10^5$	
15	0.82862	SIMON (1929)	15	1951	SIMON (1929)
30	0.80680	„	30	1768	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.42805	1.42841	1.43069	1.43079	1.43512	1.43613	1.43946	1.44106
$\frac{dn}{dt}$	0.000385	387	387	384	395	396	389	396

EYKMAN (1919) and KRAFFT (1882) have measured the density, the freezing point and the refractive index of the following compounds: Dihexylketone: $(C_6H_{13})_2$—CO; Dilaurylketone: $(C_{11}H_{23})_2$—CO; Dipalmitylketone: $(C_{15}H_{31})_2$—CO. As other data are lacking, these results cannot be considered as absolutely reliable.

METHYLKETONES.

The methylketones, from C_2 to C_{11}, were prepared by CEUTERICK (1936) starting from substituted acetylacetic esters and also by catalytic reaction of mixtures of acetic acid and homologous acids. All the compounds must be purified by using the bisulphite compound, followed by fractional distillation until constancy of density for successive fractions is attained. For the C_4 and C_5 terms, the last traces of moisture must be eliminated by drying the vapour over P_2O_5.

METHYLETHYLKETONE $CH_3.CO.C_2H_5$

Commercial methylethylketone is available in a fairly pure state. It can be purified by using the additive reaction with NaI (LOCHTE, 1924). Water is easily eliminated by distillation owing to the existence of an azeotrope (B.P.: 73°6).

Constants: B.E. (1928)

Boiling point

79°57	Marshall (1906)	79°60	$\frac{dt}{dp}$ *(10 mm):* 0°38 B.E. (1928) and Lecat (passim)
79°6	Ceuterick (1936)		
79°60	Grimm and Patrick (1923)	79°89	Mascarelli and Musatty (1911)

Freezing point

−86°4	B.E. (1928)	−86°9	Doolittle (1944)

Density

t°	d		t°	d	
0	0.82555	B.E. (1928)	15	0.81005	Marshall (1906)
15	0.81010	„	15.4	0.8096	Eykman (1893)
30	0.79452	„	15	0.81010	Ceuterick (1936)
			30	0.79452	„

Viscosity

t°	$\eta \cdot 10^5$	
15	423	B.E. (1928)
30	365	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.37882	1.37927	1.38140	1.38151	1.38530	1.38628	1.38916	1.39014	B.E. (1928)
$\frac{dn}{dt}$	0.00047	47	48	48	48	48	48	48	„
15	—	1.37910	1.38101	—	—	1.38597	—	1.38997	Ceuterick (1936)
30	—	1.37217	1.37412	—	—	1.37890	—	1.38285	„
$\frac{dn}{dt}$	—	0.00046	46	—	—	47	—	48	„
20	—	—	1.3786	—	—	—	—	—	Doolittle (1944)

Heat of vaporisation	(B.P.) 103.45 cal 15°/g	Grimm and Patrick (1923)

HIGHER METHYLALKYLKETONES

Constants Ceuterick (1936):

	B.P.	F.P.
R=*n*-propyl *n*-C_3H_7	102°35 Lecat (passim) 102°4 Bonino (1925)	−77°75 Timmermans (passim)
R=*n*-butyl *n*-C_4H_9	127°2 Lecat (passim)	−56°9 Timmermans (passim) −55°8 Doolittle (1944)
R=*n*-hexyl *n*-C_6H_{13}	172°85 Lecat (passim)	−21°5 Ceuterick (1936) −20°5 Doolittle (1944)
R=*n*-heptyl *n*-C_7H_{15}	73°8/10 mm Ceuterick (1936)	− 7°8 Ceuterick (1936)
R=*n*-octyl *n*-C_8H_{17}	90°5/10 mm ,,	3°1 ,,
R=*n*-nonyl *n*-C_9H_{19}	106°1/10 mm ,,	12°7 ,, 12°8 Doolittle (1944)
R=*n*-decyl *n*-$C_{10}H_{21}$	119°0/10 mm ,,	20°5 Ceuterick (1936)
R=*n*-undecyl *n*-$C_{11}H_{23}$	133°6/10 mm ,,	28°1 ,,

$CH_3.CO.R$

Density			Refractive index				
				15°	30°	$\frac{dn}{dt}$	
15°	0.81130	Ceuterick (1936)	Hα	1.39030	1.38379	0.00043	Ceuterick (1936)
30°	0.79656	,,	D	1.39229	1.38579	43	
			Hβ	1.39730	1.39072	44	
			Hγ	1.40138	1.39475	44	
15°	0.81581		Hα	1.40061	1.39452	0.00041	,,
30°	0.80220		D	1.40273	1.39661	41	
10°	0.8198	Gross, Rintelen	Hβ	1.40790	1.40164	42	
30°	0.8025	and Saylor (1939)	Hγ	1.41212	1.40588	42	
50°	0.7845	,,	D	(20°) 1.4008 Doolittle (1944)			
15°	0.82268	Ceuterick (1936)	Hα	1.41504	1.40892	0.00041	,,
30°	0.81023	,,	D	1.41722	1.41111	41	
			Hβ	1.42241	1.41619	42	
			Hγ	1.42682	1.42036	43	
			D	(20°) 1.4155 Doolittle (1944)			
15°	0.82536	,,	Hα	1.42153	1.41443	0.00041	,,
30°	0.81327	,,	D	1.42271	1.41675	40	
			Hβ	1.42805	1.42204	40	
			Hγ	1.43243	1.42638	40	
15°	0.82765	,,	Hα	1.42495	1.41912	0.00039	,,
30°	0.81579	,,	D	1.42720	1.42128	39	
			Hβ	1.43248	1.42664	39	
			Hγ	1.43684	1.43112	38	
15°	0.82945	,,	Hα	1.42860	1.42309	0.00037	,,
30°	0.81801	,,	D	1.43085	1.42527	37	
			Hβ	1.43633	1.43071	38	
			Hγ	1.44063	1.43509	37	
			D	(20°) 1.4291 Doolittle (1944)			
30°	0.81982	,,	Hα	—	1.42638	—	,,
			D	—	1.42855	—	
			Hβ	—	1.43398	—	
			Hγ	—	1.43847	—	
30°	0.82168	,,	Hα	—	1.42951	—	,,
			D	—	1.43175	—	
			Hβ	—	1.43719	—	
			Hγ	—	1.44166	—	

METHYL-*n*-AMYLKETONE $CH_3.CO.n\text{-}C_5H_{11}$

Constants

Boiling point		*Freezing point*	
151°45	Simon (1929)	−35°0 −35°6	Doolittle (1944) Simon (1929)

Density

t°	d		t°	d	
15	0.81966	Ceuterick (1936)	0	0.83239	Simon (1929)
30	0.80675	„	15	0.81966	„
			30	0.80680	„

Viscosity

t°	$\eta \cdot 10^5$	
15	854	Simon (1928)
30	686	„

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.40872	1.41086	1.41609	1.42029	Ceuterick (1936)
30	1.40236	1.40439	1.40947	1.41374	„
$\frac{dn}{dt}$	42	43	44	44	„
20	—	1.4088	—	—	Doolittle (1944)

The values of Ceuterick seem better than those of Simon, which are probably affected by a systematic error.

ETHYL-*n*-PROPYLKETONE: $C_2H_5.CO.n\text{-}C_3H_7$

ETHYL-*n*-PENTADECYLKETONE: $C_2H_5.CO.n\text{-}C_{15}H_{31}$.

These compounds were studied by Eykman (1919) and Krafft (1879), but there are not sufficient criteria for the purity of their products.

ETHYL-*n*-PROPYLKETONE	$C_2H_5.CO.C_3H_7$		Owen, Quayle and Clegg (1942)
„ *n*-BUTYL „	„	C_4H_9	„
„ *n*-AMYL „	„	C_5H_{11}	„
n-PROPYL-*n*-BUTYL „	$C_3H_7.CO.C_4H_9$		„
n-BUTYL-*n*-AMYL „	$C_4H_9.CO.C_5H_{11}$		„

2,2,4-TRIMETHYLPENTANONE-3	$C(CH_3)_3.CO.CH(CH_3)_2$
2,2,4,4-TETRAMETHYLPENTANONE-3	$C(CH_3)_3.CO.C(CH_3)_3$

Boiling and *freezing points, density* and *refractive index:* HOWARD, MEARS, FOOKSON, POMERANTZ and BROOKS (1947).

4-METHYLPENTEN-3-ONE-2 or MESITYLOXIDE	$(CH_3)_2C=CH.CO.CH_3$
4-METHYLPENTEN-4-ONE-2 or *Iso*-MESITYLOXIDE	$CH_2=C(CH_3).CH_2.CO.CH_3$

Critical constants, saturated vapour pressure, boiling and *freezing points, density, viscosity, surface tension, refractive index* and *heat of vaporisation:* STROSS, MONGER and FINCH (1947).

E. OXIDES

CARBON MONOXIDE CO

This substance is prepared by one of the following methods: the reaction of P_2O_5 on sodium formate; dehydration of formic acid by phosphoric or sulphuric acid; or by the reaction of concentrated sulphuric acid on potassium ferrocyanide. The gas is purified by bubbling through a solution of KOH and drying over KOH and P_2O_5, followed by fractional distillation. (MOLES and SALAZAR, 1932).

Constants. — Polyphasic equilibria

The thermometric scales used are: the Leyden scale: 0°C = 273°09 K (CROMMELIN and his collaborators; VERSCHOYLE; CLUSIUS and his collaborators and KAISCHEW); the American scale: 0°C = 273°16 K (CLAYTON and GIAUQUE).

Critical constants

t° cr.	p cr. atm.	d cr.	
−140.21	34.529	0.3010	CROMMELIN, BYLEVELD and BROWN (1931) and MATHIAS, CROMMELIN, BYLEVELD and GRIGG (1932)

Densities of the liquid and the saturated vapour

t°	L.	V.	t°	L.	V.	
−141.73	0.42200	0.19392	−169.61	0.68560	0.02824	Mathias, Crommelin,
−142.26	0.43365	0.18462	−172.18	0.69953	0.02389	Byleveld and Grigg
−142.56	0.44026	0.17767	−178.95	0.73408	—	(1932) corr. by Mathias
−143.31	0.45640	0.16357	−182.83	0.75446	—	and Crommelin (1936)
−145.30	0.49190	0.13601	−185.96	0.76904	—	,,
−147.51	0.52083	0.11607	−190.86	0.79086	—	,,
−152.21	0.56582	0.08202	−195.08	0.80640	—	,,
−164.06	0.65262	0.04014	−199.54	0.82554	—	,,
−165.50	0.66168	0.03681	−204.97	0.84714	—	,,

Rectilinear diameter: $0.55505 - 0.001912\,T^{\circ} + 7 \cdot 10^{-9}\,(T^{\circ} - 100)$ Mathias (1935)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
C. −212.754	20.41	L. −203.355	151.84	−197.086	379.95	Clusius and Teske
−211.105	30.83	−202.289	178.11	−196.665	396.91	,, (1929)
−208.198	60.99	−201.633	197.95	−196.516	408.78	,,
−206.789	79.65	−200.752	228.30	−195.593	464.82	,,
−205.727	99.63	−199.681	265.21	−195.591	464.92	,,
−204.877	117.08	−199.096	287.45	−194.825	510.62	,,
		−198.371	318.97	−194.262	546.20	,,
		−198.312	321.44	−193.394	606.66	,,
		−197.532	356.50	−193.123	624.18	,,
		−197.459	361.80			,,
C. −216.23	7.21	L. −204.95	116.15	−165.47	6897.78	Crommelin, Byle-
−210.41	36.46	−204.92	116.88	−160.89	9168.68	veld and Brown
−208.13	60.71	−199.24	282.51	−149.63	16824.44	,, (1931)
−207.42	70.52	−195.13	490.38	−147.13	18998.13	,,
−206.46	80.99	−191.64	745.30	−143.86	22165.25	,,
−205.95	97.72	−185.48	1430.42	−141.27	24995.90	,,
−205.19	110.63	−178.75	2628.74	−140.62	25748.57	,,
−205.02	114.83	−169.61	5257.26			,,
C. −218.88	3.26	L. −202.27	180.09	−192.07	709.0	,,
−215.70	8.88	−199.33	279.1	−190.87	813.2	Verschoyle (1931)
−212.78	19.80	−196.55	407.8	−188.06	1100.9	,,
−210.81	33.00	−193.95	566.0	−185.44	1431.5	,,
−207.43	70.43					,,
−205.01	115.95					,,
						,,

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
C. −212.92	19.98	L. −205.07	115.30	−197.726	352.22	Clayton and Giauque (1932)
−211.61	28.11	−204.059	136.51	−196.809	397.84	
−210.94	32.75	−203.268	155.58	−195.893	448.59	„
−209.86	42.30	−202.470	176.41	−195.050	499.34	„
−208.85	52.83	−200.933	223.64	−194.212	554.06	„
−207.88	65.46	−199.914	259.71	−193.302	618.71	„
−207.04	77.69	−199.300	283.25	−192.058	716.89	„
−206.14	93.25	−198.574	313.47	−189.928	902.06	„
						„

Boiling point

−191°37	Clusius and Teske (1929)	−191°47	Crommelin, Byleveld and Brown (1931)
−191°47	Verschoyle (1931)	−191°55	Clayton and Giauque (1932)

Triple point

−204°87/115.376 mm	Clusius and Teske (1929) and Clusius (1941)
−204°99/115.1096 mm	Crommelin, Byleveld and Brown (1931)
−204°99/115.4 mm	Kaischew (1938)
−205°03/114.86 mm	Verschoyle (1931)
−205°07/115.31 mm	Clayton and Giauque (1932)

Melting curve

t°	p atm.		t°	p atm.	
−205.03	0.15	Verschoyle (1931)	−201.505	157.06	Verschoyle (1931)
−203.745	55.53	„	−200.435	205.44	„
−202.66	103.86	„			

Transition point

−211°61	Clayton and Giauque (1932)	−211°60	Kaischew (1938)
		−211°59	Clusius (1929)

Constants of state

Weight of the normal litre in the gaseous state

1.25001 ± 0.00001	MOLES and SALAZAR (1934)

Deviation from Avogadro's law: $A_0^1 = 1.00040 \pm 0.00002$ MOLES and SALAZAR (1934)

This value corrects the following values: MOLES and SALAZAR (1932) and PIRE and MOLES (1929); it agrees with the value at 0°: 1.00048 given by SCHLÄTTER (1923) and (1930).

Expansion coefficient

(11°03 → 48°01): 3669.4 · 10^{-6}/413 mm	COPPOCK and WHYTLAW GRAY (1934)
„ 3674.4 „ /768 mm	„
(+16°42 → −190°15): 3736.08 „	ESTREICHER and BOBOTEK (1913)
(+16°30 → −150°38): 3721.79 „	„
(+18°37 → − 80°38): 3716.21 „	„
(+18°48 → 0°): 3681.56 „	„
(0° → −80°38): 3724.07 „	„
(−80°38 → −150°38): 3729.63 „	„
(−150°38 → −190°15): 3796.71 „	„

Isotherms of compressibility

(0° → 20° and 50 → 130 atm.)	BOTELLA (1929)
(0° → 20° and 1 → 125 atm.)	GOÏG (prelim. note), (1929) and (1930); BARTLETT, HETHERINGTON, KVALNES and TREMEARNE (1930)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. II −261.20	0.04335	−239.99	0.2411	C. I −209.19	0.4311	CLUSIUS (1929)
−259.66	0.06128	−237.39	0.2625	−207.89	0.4371	„
−257.74	0.07435	−234.59	0.2835	−206.89	0.4411	„
−256.90	0.08235	−231.49	0.3085	L. −202.99	0.5118	„
−255.01	0.09525	−228.39	0.3271	−198.89	0.5157	„
−253.56	0.1084	−225.49	0.3514	−196.79	0.5189	„
−253.09	0.1142	−222.59	0.3743	−193.09	0.5236	„
−251.19	0.1333	−220.29	0.3982	−191.79	0.5268	„
−249.19	0.1537	−217.89	0.4250			„
−244.39	0.2074	−216.09	0.4576			„
−242.19	0.2231					„

Specific heat (continued)

C. II −258.80	0.05846	−228.45	0.3246	L. −203.14	0.5150	Clayton and
−256.22	0.08778	−225.26	0.3531	−200.99	0.5153	Giauque (1932)
−253.79	0.1167	−224.82	0.3545	−197.69	0.5171	,,
−251.23	0.1420	−220.82	0.3932	−197.36	0.5139	,,
−248.85	0.1633	−218.09	0.4189	−194.38	0.5146	,,
−246.52	0.1825	−216.34	0.4539	−194.10	0.5171	,,
−244.15	0.2029	−214.12	0.4857	−192.55	0.5178	,,
−241.60	0.2240	C. I −209.69	0.4293	−189.77	0.5143	,,
−233.31	0.2896	−208.61	0.4328	−188.50	0.5161	,,
−228.95	0.3234	−207.14	0.4393			,,
C. II −218.87	0.4136	C. I −209.83	0.4307	L. −202.16	0.5114	Kaischew(1938)
−216.72	0.4396	−208.94	0.4318	−201.88	0.5143	,,
−216.43	0.4482	−207.41	0.4396	−200.85	0.5107	,,
−214.76	0.4750	−206.76	0.4414	−199.51	0.5121	,,
−214.58	0.4803			−199.50	0.5125	,,
−213.85	0.4903			−199.29	0.5139	,,
				−198.71	0.5153	,,
				−197.58	0.5143	,,
				−197.28	0.5125	,,

N.B. For the liquid, these results agree sufficiently, considering the experimental difficulties.

Heat of vaporisation	(B.P.)	51.557 cal 15°/g	Clayton and Giauque (1932)
Heat of melting		7.132 ,,	,,
		7.175 ,,	Kaischew (1938)
		7.196 ,,	Clusius (1929)
Heat of transition		5.389 ,,	Kaischew (1938)
		5.400 ,,	Clusius (1929)
		5.403 ,,	Clayton and Giauque (1932)
Heat of combustion	25° (c_p)	2.4152 ,,	Rossini (1931)

CARBON DIOXIDE CO_2

Prepared by decomposition of $NaHCO_3$ by heat. The gas is purified by bubbling through H_2SO_4 and drying over P_2O_5, followed by fractional distillation. (Cardoso and Bell, 1912, Guye and Pintza, 1905–07).

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. atm.	d cr.	
30.96	—	—	Kennedy (1929)
—	—	0.4587	Keyes and Kennedy (1917)
30.98	72.93	0.468	Keesom (1903)

Critical constants (continued)

t° cr.	p cr atm.	d cr.	
30.985	—	0.460	Kamerlingh Onnes and Fabius (1906-07)
31.00	72.85	—	Cardoso and Bell (1912)
31.00	—	—	Verschaffelt (1896)
31.00	72.80	—	Meyers and Van Dusen (1933)
31.04	72.85	0.467	Michels (1937)
31.10	73.00	0.459	Dorsman (1908)
31.12	—	—	Brinkman (1904)

Densities of the liquid and the saturated vapour

t°	L.	V.	t°	L.	V.	
22.9	0.7422	0.2163	6.2	0.8878	0.1217	Lowry and Erickson (1927)
17.2	0.8045	0.1721	1.2	0.9198	0.1029	
15.2	0.8216	0.1607	−1.8	0.9378	0.0940	„
11.2	0.8547	0.1390	−5.8	0.9604	0.0803	„
2.853	0.91299	0.10684	28.052	0.65578	0.28956	Michels (1937)
10.822	0.85724	0.13881	29.929	0.59509	0.34064	„
19.874	0.77698	0.19299	30.409	0.57393	0.36026	„
25.070	0.71134	0.24252	31.013	0.51205	0.42783	„
25.298	0.70719	0.24608				„

Saturated vapour pressure

t°	$p\,\text{mm}\cdot 10^4$	t°	$p\,\text{mm}\cdot 10^4$	t°	$p\,\text{mm}\cdot 10^4$	
C. −183.0	0.06	−171.01	3.03	−167.04	9.825	Kamerlingh Onnes and Weber (1913)
−175.37	0.795	−168.83	5.93			
C. −168.83	6.01	−158.55	209.6	−140.63	3822	Weber (1913)
−164.03	22.5	−155.00	359.1	−138.69	5401	„
−163.19	28.2	−148.27	882.90	−136.78	9514.1	„
−161.39	44.4	−145.44	1537	−134.67	10728	„
−159.72	66.0	−143.07	2428			„

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
C. −127.21	3.50	−99.27	112.66	−82.60	538.4	Siemens (1913)
−122.11	7.36	−98.06	127.77	−81.86	573.2	„
−117.77	13.09	−95.02	172.9	−80.85	622.7	„
−116.33	15.79	−92.65	217.1	−80.04	667.1	„
−113.51	22.65	−89.88	283.1	−79.59	692.1	„
−110.56	32.19	−87.58	348.9	−79.05	723.0	„
−106.63	50.39	−87.09	364.1	−78.46	759.7	„
−101.57	88.44	−84.46	459.4	−77.38	830.1	„
C. −118.964	11.32	−102.469	80.39	−85.804	407.18	Giauque and Egan
−114.757	19.40	−98.472	122.20	−80.497	643.36	„ (1937)
−110.563	32.21	−94.591	179.94	−78.178	771.62	„
−106.456	51.86	−90.827	257.85	−77.329	835.30	„
C. −109.74	35.7	−87.52	350.3	−63.13	2800.600	Kuenen and Robson
−108.97	38.9	−78.32	760.000	−62.47	2894.840	„ (1902)
−108.73	40.1	−76.90	814.720	−61.60	3033.160	„
−102.96	76.6	−71.41	1279.080	−61.41	3053.680	„
−98.89	117.7	−63.36	2378.040	−57.87	3606.960	„
−95.92	158.7	−61.80	2584.320	−57.80	3604.680	„
−87.91	338.5	−57.86	2720.800	−56.24	3876.00	„
C. −87.50	351.7	−83.50	500.0	−79.50	697.2	Thiele and Schulte
−87.00	369.4	−83.00	521.3	−79.00	725.6	„ (1920)
−86.50	387.2	−82.50	543.6	−78.61	750.0	„
−86.00	404.9	−82.00	566.6	−78.50	757.2	„
−85.50	422.5	−81.50	590.8	−78.46	760.0	„
−85.00	440.3	−81.00	615.3	−78.00	789.1	„
−84.50	458.0	−80.50	641.9	−77.50	821.5	„
−84.00	479.0	−80.00	669.1	−77.00	854.5	„
C. −78.797	742.44	−70.005	1475.9	−59.851	3104.46	Meyers and Van
−78.559	757.1	−69.537	1538.7	−56.760	3845.6	Dusen (1926)
−78.506	760.5	−60.265	3017.2	−56.653	3871.0	„
−77.800	804.7	−60.222	3024.8	−56.629	3878.69	„
−70.148	1469.83	−60.134	3044.74			„
L. −56.18	3876.0	−33.08	9568.4	−15.27	16894.8	Kuenen and Robson
−54.60	4102.0	−32.68	9576.0	−9.95	19775.2	„ (1902)
−47.58	5578.4	−27.01	11719.2			„
−41.02	7189.6	−21.67	13923.2			„

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
L. −56.476	3905.4	−35.002	9028.6	24.998	48248	Meyers and Van Dusen (1926)
−55.221	4122.1	−30.005	10716.8	25.018	48260	
−50.781	4965.7	0	26140.0	29.986	54054	„
−50.534	5015.6	+ 5.001	29771.4	30.950	55274	„
−50.002	5127.6	9.995	33759.4	31.081	55438	„
−45.011	6246.8	15.000	38148.9			„
−40.005	7543.6	20.000	42960			„
L. 2.853	28117.72	25.070	48226.56	29.929	53961.52	Michels (1937)
10.822	34398.36	25.298	48481.16	30.409	54552.80	„
19.874	42763.68	28.052	51692.92	31.013	55325.72	„
L. 0	26144.7					Bridgeman (1927)

Isotherms

Near the critical point and the coexistence curve: Michels, Blaisse and Michels (1937)

Between 25° → 60° and from 60 to 140 atm. Keesom (1903)
„ 25° and 150° and above 3000 atm. Michels, Bijl and Michels (1937)
„ 0° „ „ „ „ „ Michels and Michels (1937)
„ „ „ „ „ below „ Michels (1937)
„ −37° „ +30° „ between 10 and 70 kg/cm²: Jenkins (1921)

Thermodynamical properties as *function of density, temperature* and *pressure:* Michels and De Groot (1948)

Triple point

−56°602	3885.2 mm	Meyers and Van Dusen (1933)
−56°24	3876 mm	Kuenen and Robson (1902)

Constants of state. — Gaseous State.

Weight of the normal litre

1.976938 g	Moles and Toral (1936)
$Lp = 1.963331 + 0.013606\,p$ (p = atm.)	„
1.976935 g	Moles and Escribano (1938)
$Lp = 1.963340 + 0.013595\,p$	„

Deviation from Avogadro's law: $A_0^1 = 1.00706$ Guye and Batuecas (1923).

Coefficient of expansion: (12° → 48°) = 3725.10^{-6} Coppock and Whytlaw Gray (1934).

Dielectric constant: Van Itterbeek and Spaepen (1946); Van Itterbeek and De Clippeleir (1946—47).

Liquid State. *Specific volume at various temperatures and pressures:* Jenkins (1921).

Surface tension

t°	γ	t°	γ	t°	γ	
L. −52.2	16.54	−11.3	6.81	10	2.94	Quinn (1927)
−42.7	13.88	− 6	5.79	15	2.09	„
−32.3	11.25	0	4.62	20	1.37	„
−21.7	9.05	5	3.75	25	0.59	„

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −257.64	0.0138	−211.90	0.1659	−148.58	0.2372	Giauque and Egan
−252.01	0.03225	−206.92	0.1751	−142.98	0.2429	„ (1937)
−249.91	0.04070	−201.94	0.1828	−137.42	0.2472	„
−245.44	0.06082	−196.69	0.1902	−132.02	0.2517	„
−243.24	0.06974	−191.22	0.1978	−126.68	0.2561	„
−240.37	0.08078	−185.71	0.2041	−121.49	0.2602	„
−237.17	0.09234	−180.45	0.2088	−116.44	0.2645	„
−233.73	0.1046	−175.23	0.2141	−111.16	0.2689	„
−229.97	0.1180	−170.00	0.2198	−105.54	0.2743	„
−225.54	0.1316	−164.60	0.2248	− 99.80	0.2800	„
−221.05	0.1437	−159.25	0.2288	− 88.58	0.2913	„
−216.99	0.1537	−153.92	0.2334	− 83.38	0.2966	„
−212.30	0.1652					„
C. −253.76	0.0245	−238.46	0.0886	−186.76	0.2089	Eucken (1916)
−251.16	0.0329	−235.36	0.0995	−184.76	0.2114	„
−249.71	0.0402	−231.86	0.1154	−77.86	0.2964	„
−247.76	0.0468	−228.96	0.1241	−74.26	0.2991	„
−246.76	0.0539	−193.01	0.2011	−73.56	0.3023	„
−243.86	0.0648	−191.16	0.2023	−72.66	0.3036	„
−241.36	0.0745	−190.41	0.2043			„

Specific heat (continued)

t°	c_p	t°	c_p	t°	c_p	
C. −193.16	0.2000	−143.16	0.2523	−93.16	0.2841	Eucken and Hauck
−183.16	0.2136	−133.16	0.2591	−83.16	0.2902	„ (1928)
−173.16	0.2239	−123.16	0.2659	−73.16	0.3000	”
−163.16	0.2329	−113.16	0.2716	−63.16	0.3114	„
−153.16	0.2432	−103.16	0.2784			”
L. −53.16	0.4307	−23.16	0.4727	6.84	0.5898	Eucken and Hauck
−43.16	0.4454	−13.16	0.4886	16.84	0.7068	„ (1928)
−33.16	0.4614	− 3.16	0.5295			”

The curves drawn according to the values given by Giauque and Egan (1937) and by Eucken and Hauck (1928) are regular, but they do not agree absolutely, probably owing to a difference in the temperature scale.

Heat of vaporisation

t°	cal 15°/g	t°	cal 15°/g	
−50	79.9	−10	60.9	Jenkin and Pye (1914)
−45	77.8	− 5	57.7	”
−40	75.7	0	54.1	”
−35	73.6	5	50.3	”
−30	71.3	10	46.2	”
−25	69.0	15	41.9	”
−20	66.5	20	36.55	”
−15	63.8			”

F. ANHYDRIDES

ACETIC ANHYDRIDE $(CH_3CO)_2O$

Constants

Saturated vapour pressure

t°	p mm		t°	pmm	
37.2	7.5	Kahlbaum (1885)	47.0	17.5	Kahlbaum (1885)
39.9	10	„	49.2	20	„
42.6	12.5	„	50.8	22.5	„
44.9	15	„			

Boiling point: 140°0 B.E. (1930)

Freezing point: –73°0 Timmermans

Density

t°	d		t°	d	
0	1.10526	B.E. (1930)	25	1.0749	Lewis (1940)
15	1.08712	„	30	1.0690	„
30	1.06911	„	35	1.0629	„
			40	1.0567	„
15	1.0870	Lewis (1940)	45	1.0505	„
20	1.0810	„	50	1.0443	„

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	t°	γ	
15	971	B.E. (1930)	15	33.14	35	30.76	Lewis (1940)
30	783	„	20	32.56	40	30.05	„
			25	31.90	45	29.57	„
			30	31.24	50	29.00	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ	
15	1.38971	1.39001	1.39229	1.39620	1.39717	1.40028	1.40118	B.E. (1930)
$\frac{dn}{dt}$	0.00040	39	41	41	40	42	—	

PROPIONIC ANHYDRIDE $(C_2H_5CO)_2O$

Constants

Saturated vapour pressure: Kahlbaum (1885)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
55.6	7.5	62.3	12.5	67.8	17.5	72.8	22.5
59.1	10	65.1	15	70.4	20		

Boiling point: 167° Kahlbaum (1885)

Freezing point: −45° Timmermans (passim)

n-CAPROIC ANHYDRIDE $(n\text{-}C_5H_{11}CO)_2O$

Constants: Simon (1929)

Freezing point: −40°5

Density *Viscosity*

t°	d		t°	$\eta \cdot 10^5$	
0	0.93630	Simon (1929)	15	3238	Simon (1929)
15	0.92397	,,	30	2313	,,
30	0.91155	,,			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.42883	1.42912	1.43146	1.43156	1.43588	1.43694	1.44029	1.44163
25	1.42530	1.42556	1.42796	1.42806	1.43219	1.43332	1.43668	1.43791
$\frac{dn}{dt}$	0.00035	36	35	35	37	36	36	37

G. FATTY ACIDS

Generally, the acids are prepared by saponification of the nitriles or of the amides, or by decarboxylation of the corresponding substituted malonic acids.

FORMIC ACID $H.CO_2H$

Formic acid is subjected to fractional distillation and fusion until constancy of the melting point and of the critical solution point in benzene for several consecutive fractions. Morton (1919) obtained the anhydrous acid by distillation under reduced pressure in the presence of P_2O_5.

Constants: B.E. (1930). — **Polyphasic equilibria**

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
L. −5.23	8.12	39.89	85.18	110.62	1017.6	Coolidge (1930)
0.00	11.16	49.93	130.1			„
+8.25	17.94	59.98	192.7	C. −5.07	4.98	„
12.57	22.72	70.04	280.6	0.00	8.22	„
20.00	33.55	79.93	395.6	+8.25	17.94	„
29.96	54.36	100.68	762.5			„
17.5	29.1	59.7	187.8			Konowalow (188
40.5	85.5	70.1	280.2			„
21.9	34.3	52.9	141.8	82.3	424.6	Schmidt (1891)
25.2	40.9	54.5	150.5	83.6	448.1	„
35.0	65.0	57.5	171.5	84.1	452.0	„
37.3	72.6	59.1	182.0	85.9	479.5	„
41.8	88.6	62.8	211.5	87.5	506.1	„
42.3	90.6	64.1	221.4	90.0	544.5	„
45.8	105.9	66.7	244.6	93.6	614.8	„
47.1	111.9	67.7	254.6	94.1	624.3	„
49.3	121.0	74.2	319.7	96.2	668.6	„
52.0	135.9	80.1	393.9	98.5	718.1	„
50	127.2	60	191.2	75	335.6	Landolt (1868)
55	156.5	65	232.1			„
10	19.88	—	—	—	—	Coolidge (1928)

Boiling point

100°502	Josefowicz (1938)
100°70	$\frac{dt}{dp}$ *(10 mm):* 0°40 B.E. (1930)
100°75	„ 0°40 Lecat
100°8	Alpert and Elving (1949)

Freezing point

8°51	Faucon (1910)	8°40	Pleskov (1946)
8°50	Joukovsky (1934)	8°40	B.E. (1930)
8°50	Deffet (1935)	8°4	Bateman and Hughes (1937)
8°5	Kendall (1914)	8°39	Ewins (1914)
8°40	Wrewski and Glagolewa (1928)	8°30	Stout and Fisher (1941)
8°40	Lange (1940)	8°3	Udovenko and Ayrapetova (1947)

Melting curve: Deffet (1935)

t°	p kg/cm²		t°	p kg/cm²	
8.50	1		17.50	752	
12.50	335		20.00	964	
15.00	548				

Critical solution point: in C_6H_6 74°15 B.E. (1930)

Constants of state

Density

t°	d		t°	d	
15	1.22647	B.E. (1930)	18	1.2224	Schlesinger and Colman
25	1.21405	„	25	1.2142	„ (1916)
30	1.20775	„	15	1.22627	Perkin (1884–85)
40	1.19538	„	25	1.21384	„

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
7.59	2385	Thorpe and Rodger	64.20	838	Thorpe and Rodger
15.96	1951	„ (1894)	72.05	754	„ (1894)
24.16	1635	„	80.22	681	„
32.86	1379	„	88.19	619	„
40.36	1208	„	97.23	558	„
48.03	1064	„	15	1966	B.E. (1930)
56.30	937	„	30	1443	„

Surface tension

t°	γ	
15	38.13	B.E. (1930)
20	37.58	,,
30	36.48	,,

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.37095	1.37137	1.37348	1.37747	1.37847	1.38137
$\frac{dn}{dt}$	0.00038	38	38	38	38	39

Magnetic rotatory power: 20°8 0.7990 PERKIN (1884–85)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −258.05	0.0104	−179.28	0.1730	−52.79	0.2779	STOUT and FISHER (1941) (M.W. 46.026)
−255.73	0.0146	−172.31	0.1818	−45.55	0.2857	
−253.39	0.0203	−165.38	0.1900	−38.26	0.2892	,,
−250.72	0.02683	−158.27	0.1977	−31.21	0.2940	,,
−247.85	0.03346	−151.47	0.2047	−24.32	0.2976	,,
−244.82	0.04145	−144.59	0.2108	−17.53	0.3029	,,
−241.67	0.05014	−137.42	0.2177	−10.98	0.3079	,,
−238.37	0.05953	−131.11	0.2227	− 4.54	0.3129	,,
−234.79	0.06944	−124.11	0.2275	+ 1.82	0.3311	,,
−230.51	0.07974	−117.45	0.2333	L. 2.18	0.5082	,,
−225.71	0.09045	−109.61	0.2394	6.58	0.5104	,,
−220.46	0.1023	−102.47	0.2440	11.06	0.5117	,,
−215.02	0.1132	− 95.36	0.2490	16.22	0.5132	,,
−209.94	0.1228	− 88.16	0.2540	17.66	0.5134	,,
−204.54	0.1328	− 80.98	0.2581	21.80	0.5141	,,
−198.78	0.1432	− 73.80	0.2629	26.69	0.5145	,,
−192.63	0.1536	− 66.89	0.2679			,,
−186.22	0.1634	− 60.03	0.2731			,,

Heat of vaporisation	**25° 103.3 cal 15°/g**	STOUT and FISHER (1941)
Heat of melting	**65.87 ,,**	,,
	66.05 ,,	LANGE (1940)

ACETIC ACID $CH_3.CO_2H$

Acetic acid is distilled under reduced pressure in the presence of P_2O_5. It is then subjected to fractional distillation and fusion until constancy of melting point for successive fractions.

Constants: B.E. (1930). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
321.6	43400	0.3506	Young (1910)

Density of the liquid and saturated vapour

t°	L.	V.	t°	L.	V.
20	1.0491	0.0000764	180	0.8555	0.01370
30	1.0392	0.0001264	190	0.8413	0.01681
40	1.0284	0.0002012	200	0.8265	0.02052
50	1.0175	0.0003100	210	0.8109	0.02488
60	1.0060	0.0004621	220	0.7941	0.03021
70	0.9948	0.000673	230	0.7764	0.03626
80	0.9835	0.000959	240	0.7571	0.04327
90	0.9718	0.001338	250	0.7364	0.05163
100	0.9599	0.001833	260	0.7136	0.06165
110	0.9483	0.002468	270	0.6900	0.07365
120	0.9362	0.003271	280	0.6629	0.0883
130	0.9235	0.004275	290	0.6334	0.1073
140	0.9091	0.005515	300	0.5950	0.1331
150	0.8963	0.00703	310	0.5423	0.1718
160	0.8829	0.00887	320	0.4615	—
170	0.8694	0.01084	321.6	0.3506	0.3506

Rectilinear diameter: $0.5355 - 0.0005366\ t° - 0.0000001191\ t°^2$ Young (1910)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
C. −5.68	1.3	7.20	4.05	13.96	7.30	Ramsay and Young
−0.60	1.95	8.40	4.25	14.85	8.00	,, (1885)
+1.85	2.35	8.72	4.60	15.15	8.40	,,
2.86	2.80	9.16	4.70	15.80	8.85	,,
5.32	3.30	10.40	5.30	16.09	8.95	,,
6.30	3.70	11.39	5.75	16.20	9.10	,,
6.41	3.75	11.70	6.15	16.32	9.15	,,
6.68	3.85	12.60	6.65	16.41	9.45	,,
7.09	4.00					,,

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
L. 0	3.50	110	582.6	230	10402	Young (1910); Ramsay and Young (1885)
10	6.34	130	1040	240	12501	
20	11.80	140	1381	250	14866	„
30	19.90	150	1875	260	17579	„
40	34.00	160	2409	270	20651	„
50	56.20	170	3058	280	24123	„
60	88.30	180	3833	300	32043	„
70	137.10	190	4733	310	36943	„
80	202.1	200	5833	320	42553	„
90	292.8	210	7125	321.6	43400	„
100	416.5	220	8638			„
25	15.43	Hovorka and Dreisbach (1934)				
49.99	55.4	Zawidzki (1900)				
69.94	136.5	„				

Boiling point

118°1	$\frac{dt}{dp}$ *(10 mm) :* 0°42 Lecat	118°5	Beckman and Liesche (1914)
		118°5	Young (1910)
118°2	„ 0°42 B.E. (1930)	118°7	Mündel (1913)
118°1	Alpert and Elving (1949)	118°7	Kahlbaum and Schroeter (1898)

Freezing point

16°55	B.E. (1930) and Deffet (1935)	16°62	De Forcrand (1903)
16°5965	De Visser (1891–1893) (hydrogen therm.)	16°63	Wrewsky, Miscenko and Muromzew (1928)
16°6713	„ (therm. in hart glas)	16°63	Hall and Voge (1933)
16°6	Udovenko and Ayrapetova (1947)	16°63	Hovorka and Dreisbach (1934)
16°60	Eichelberger and La Mer (1933)	16°63	Pool, Harwood and Ralston (1945)
16°60	Bousfield and Lowry (1911)	16°635	Hess and Haber (1937)
16°60	Mac Dougall (1936)	16°70	Faucon (1910 and 1909)
16°60	Louguinine and Dupont (1911)	16°70	Baud (1913)
16°60	Jones and Betts (1928)	16°70	Parks and Kelley (1925)

Melting curve

t°	p kg/cm²		t°	p kg/cm²	
16.55	1	DEFFET (1935)	30.00	663	DEFFET (1935)
20.00	168	„	35.00	907	„
25.00	415	„	36.00	957	„

Constants of state

Density

t°	d		t°	d	
20	1.0491	YOUNG (1910)	18	1.05148	BOUSFIELD and LOWRY
20	1.04926	B.E. (1930)	20	1.04922	„ (1911)
30	1.03802	„	16.67	L. 1.05315	DE VISSER (1891–93)
40	1.02679	„	16.596	S. 1.26585	„

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
30.86	1025	THORPE and RODGER	84.53	534	THORPE and RODGER
39.88	903.1	„ (1894)	93.97	484	„ (1894)
48.47	806	„	102.89	445	„
57.46	721	„	112.57	406	„
68.10	638	„	15	1314	B.E. (1930)
76.66	580	„	30	1040	„

Surface tension

t°	γ	
15	27.95	HENNAUT-ROLAND and LEK (1931)
20	27.42	„
30	26.34	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.37131	1.37165	—	1.37392	1.37767	1.37851	1.38152	1.38297	B.E. (1930)
$\frac{dn}{dt}$	0.00038	37	—	38	39	38	40	—	„
25	—	—	1.3698	—	—	—	—	—	PUSCHIN and MATAVULJ (1932)

Dielectric constant

t°	η		t°	η	
20	6.170	Le Fevre (1938)	60	6.512	Le Fevre (1938)
25	6.195	„	70	6.631	„
40	6.309	„	80	6.800	„
50	6.401	„			

Magnetic rotatory power

t°	λ 589.3	λ 546	λ 436	
15.2	0.6675	0.7838	1.2836	Schwers (1912)
32.0	0.6568	0.7712	1.2625	„

Heat constants

Specific heat: Parks and Kelley (1925)

t°	c_p	t°	c_p	t°	c_p
C. −185.7	0.187	−177.6	0.197	−75.4	0.266
−184.0	0.189	−177.0	0.197	−74.2	0.268
−182.7	0.190	−173.1	0.200	−40.6	0.288
−182.4	0.192	−119.6	0.239	−34.2	0.296
−178.4	0.195	− 78.5	0.262	−17.6	0.311
L. 19.5	0.488				
21.6	0.491				

Heat of melting	45.91 cal 15°/g	Meyer (1910)

PROPIONIC ACID $C_2H_5.CO_2H$

The commercial product, purified by fractional distillation, shows the same constants as the sample obtained by synthesis from pure propionitrile.

Constants: B.E. (1930). — **Polyphasic equilibria**

Critical temperature: 337°6 Schmidt (1891)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
79.4	74.4	95.2	148.1	108.4	249.6	Kahlbaum and Wirkner (1897)
80.0	76.5	95.6	151.0	110.8	273.5	„
80.3	77.7	98.9	173.6	113.1	297.9	„
83.5	90.4	99.5	176.7	115.6	326.2	„
85.8	99.5	100.8	196.8	117.6	350.2	„
86.0	100.5	102.3	200.4	119.4	373.9	„
91.5	126.3	105.4	226.6	119.5	375.1	„
						„
46.2	13.2	59.3	26.8	71.6	49.7	Kahlbaum and Schroeter (1893–94)
47.2	14.0	60.2	27.9	72.4	51.9	„ (*Dynamic method*)
48.9	15.2	61.2	29.7	73.2	54.0	„
50.2	16.5	62.6	31.9	74.0	55.8	„
51.2	17.7	63.6	33.6	74.9	58.1	„
52.4	18.6	64.9	35.6	76.2	61.8	„
53.5	19.8	65.8	37.2	77.0	64.3	„
54.9	21.4	67.0	39.5	77.8	66.6	„
55.9	22.5	68.0	41.3	78.8	70.3	„
56.7	23.5	69.0	43.7	79.5	72.4	„
57.7	24.7	69.8	45.6			„
58.5	25.7	70.7	47.6			„
27.6	3.3	35.3	6.1	40.2	9.0	Kahlbaum and Schroeter (1893–94)
30.8	4.3	36.4	6.6	42.1	9.9	„ (*Static method*)
31.5	4.5	37.0	7.0	45.2	12.3	„
33.5	5.2	38.3	7.7	46.2	13.2	„
35.2	6.1	40.3	8.7	46.5	13.4	„
39.7	8.37	65.2	35.87	113.7	303.44	Richardson (1886)
46.7	13.20	77.7	66.27	120.3	388.80	„
49.6	15.84	83.2	86.45	135.7	650.00	„

Boiling point

141°22	Eykman (1919)
141°3	$\frac{dt}{dp}$ *(10 mm):* 0°43 Lecat
141°35	„ B.E. (1930)

Freezing point

−20°8	B.E. (1930) and Deffet (1935)

Melting curve: DEFFET (1935)

t°	p kg/cm²		t°	p kg/cm²	
−20.8	1		−5.0	775	
−15.0	260		0	1033	
−10.0	517				

Constants of state

Density

t°	d		t°	d	
0	1.01503	B.E. (1930)	14.85	0.9988	EYKMAN (1895–1919)
15	0.99874	,,	15.15	0.9987	,,
30	0.98260	,,	18.7	0.99483	JAHN and MÖLLER (1894)
			20	0.9930	SCHJÄNBERG (1935)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
30	956	DUNSTAN (1915)	15	1175	B.E. (1930)
40	841	,,	30	958	,,
60	668	,,	25	1020	DUNSTAN, THOLE and BENSON (1914)
80	544	,,			
90	495	,,			

Surface tension

t°	γ	
15	27.21	B.E. (1930) and HENNAUT-ROLAND and LEK (1931)
20	26.70	,,
30	25.71	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.38630	1.38658	—	1.38879	1.39267	1.39355	1.39655	1.39752	B.E. (1930)
$\frac{dn}{dt}$	0.00038	38	—	38	40	40	42	42	„
20	—	1.38453	—	—	—	1.39127	—	1.39497	Schjänberg (1935)
25	—	—	1.3848	—	—	—	—	—	Broughton (1934)

Magnetic rotatory power: 20°3 0.8369 Perkin (1885)

Heat constants

Heat of combustion	18°5 → 20°, (c_v) 4931.5 cal 15°/g	Schjänberg (1935)

n-BUTYRIC ACID $n\text{-}C_3H_7.CO_2H$

Constants: B.E. (1932). — **Polyphasic equilibria**

Critical temperature: 354°74 Brown (1903)

Saturated vapour pressure: Schmidt (1891)

t°	p mm	t°	p mm	t°	p mm
107.3	99.0	118.3	156.8	129.5	243.0
108.4	103.0	118.9	160.9	131.5	261.5
109.8	110.1	122.8	189.2	134.5	291.6
110.2	111.3	123.2	190.2	136.9	318.5
114.1	131.1				
115.6	139.1				

Boiling point *Freezing point*

164°0	$\frac{dt}{dp}$ *(10 mm):* 0°45 LECAT	−5°50	B.E. (1932) and DEFFET (1935)
		−5°55	DE MOL (1925)
164°05	„ 0°45 B.E. (1932)		

The values of the boiling and freezing points of DREISBACH and MARTIN (1949) do not agree with those of the other authors.

Melting curve: DEFFET (1935)

t°	p kg/cm²	t°	p kg/cm²	
−5.50	1	10.15	837	
0.00	290	13.00	986	
5.15	567			

Critical solution point: in H_2O: −4°1 B.E. (1932)

Constants of State.

Density

t°	d		t°	d	
24.7	0.9534	FALK (1909)	10	0.9682	GARTENMEISTER (1890)
32.4	0.9457	„	20	0.9580	„
40.8	0.9373	„	30	0.9479	„
48.0	0.9302	„	40	0.9377	„
58.8	0.9198	„	50	0.9274	„
67.4	0.9113	„	0	0.97762	B.E. (1932)
20	0.95767	DREISBACH and MARTIN	15	0.96286	„
25	0.95273	„ (1949)	30	0.94797	„
14	0.9638	EYKMAN (1919)	0	0.97773	DE MOL (1925)
25	0.9528	MERRY and TURNER (1914)	15	0.96305	„
25	0.9528	BILTZ, FISCHER and WÜNNENBERG (1930)			

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	1814		15	27.32	
30	1385		20	26.74	
			30	25.57	

Refractive index

t°	He r.	H	D	He y.	He g.	He	He v.	H	
15	1.39775	1.39803	—	1.40030	1.40425	1.40510	1.40814	1.40963	B.E. (1932)
$\frac{dn}{dt}$	0.00042	42	—	43	44	44	45	45	„
20.3	—	1.39582	1.39777	—	—	1.40271	—	1.40685	Falk (1909)
23.0	—	1.39459	1.39662	—	—	1.40157	—	1.40567	„
31.1	—	1.39161	1.39364	—	—	1.39850	—	1.40256	„
32.7	—	1.39093	1.39291	—	—	1.39779	—	—	„
$\frac{dn}{dt}$	—	0.0003985	395	—	—	3985	—	404	„
20	—	—	1.39796	—	—	—	—	—	Dreisbach and Martin (1949)
25	—	—	1.39581	—	—	—	—	—	
$\frac{dn}{dt}$	—	—	0.00043	—	—	—	—	—	„
18	—	—	1.3990	—	—	—	—	—	Whitby (1926)
70	—	1.3756	1.3775	—	—	1.3822	—	1.3859	Waterman and Bertram (1927)

Iso-BUTYRIC ACID $(CH_3)_2CH.CO_2H$

Constants: B.E. (1934). — **Polyphasic equilibria**

Critical temperature: 336°25 Brown (1906)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
68.2	22.4	84.6	51.4	96.2	88.7	105.8	133.9	Kahlbaum and Wirkner (1897)
73.8	30.3	87.4	58.9	99.1	100.7	110.8	165.3	„
79.6	40.7	92.6	74.9	99.3	102.0	115.4	197.5	„
84.5	51.3	93.0	76.5	100.5	106.9	119.4	231.1	„
58.4	12.2	66.1	19.2	75.0	30.9	82.5	45.1	Kahlbaum and Schroeter (1893)
59.0	12.7	67.5	20.9	76.5	33.4	83.2	47.0	„
59.6	13.2	68.6	22.1	77.9	36.0	84.4	50.0	„
61.2	14.6	69.8	23.6	79.0	38.0	85.6	52.7	„
62.7	15.8	71.0	25.2	79.6	39.0	86.3	55.0	„
62.9	16.0	71.8	26.2	80.3	40.3	87.4	58.3	„
64.1	17.2	72.8	27.4	80.8	41.7	87.9	59.2	„
64.8	17.8							„
67.20	20.90	104.80	127.90	124.3	283.66	131.20	358.84	Richardson (1886)
89.8	66.369	110.30	160.00	126.80	308.57	143.80	552.24	„
96.3	89.09							„

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
119.7	243.7	134.7	414.2	143.0	504.9	SCHMIDT (1891)
121.3	257.8	135.5	428.0	145.7	599.9	„
123.5	279.9	136.4	441.2	146.2	612.2	„
125.6	303.1	138.2	471.1			„
126.1	306.9	140.0	498.0			„

Boiling point *Freezing point*

154°6	$\frac{dt}{dp}$ *(10 mm):* 0°46 LECAT	−46°1	B.E. (1934)
154°70	„ 0°46 B.E. (1934)		

Critical solution point: in H_2O: 26°20 B.E. (1934)

Constants of state

Density

t°	d		t°	d	
−45.0	1.01462	TIMMERMANS (1912)	0	0.96815	B.E. (1934)
−35.3	1.00430	„	15	0.95296	„
−30.6	1.99930	„	30	0.93782	„
−22.95	0.99136	„			
−13.1	0.98141	„			
− 6.2	0.97450	„			
0	0.96820	„			
+17.5	0.95060	„			

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	1440	B.E. (1934)	15	25.55	B.E. (1934)
30	1126	„	20	25.13	„
25	1220	THOLE (1914)	30	24.22	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.39287	1.39332	1.39646	1.39933	1.40038	1.40351
$\frac{dn}{dt}$	0.00039	40	40	40	42	42

n-VALERIC ACID $n\text{-}C_4H_9.CO_2H$

Constants: B.E. (1932)

Critical temperature: 378°87 BROWN (1906)

Boiling point:

186°2	EYKMAN (1919)
186°34	$\frac{dt}{dp}$ *(10 mm)*: 0°51 HANUS (1925)
186°35	„ 0°47 B.E. (1932)
186°35	„ 0°46 LECAT (passim)

Freezing point: –34°5

Melting curve: DEFFET (1935)

t°	p kg/cm²	t°	p kg/cm²
–34.5	1	–20.0	903
–30.0	320	–19.0	968
–25.0	601		

Density

t°	d		t°	d	
0	0.95744	B.E. (1932)	25	0.9348	BILTZ, FISCHER and WÜNNENBERG (1930)
15	0.94374	„			
30	0.93017	„	0	0.95730	LIEVENS (1924)
18.15	0.9411	EYKMAN (1906–19)	15	0.94354	„
19.1	0.9397	„	0	0.95741	HANUS (1925)
			15	0.94372	„

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	2359	B.E. (1932)	15	27.83	B.E. (1932)
30	1774	„	20	27.36	„
			30	26.35	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ	
15	1.40781	1.40820	1.41049	1.41455	1.41555	1.41864	1.42006	B.E. (1932)
$\frac{dn}{dt}$	0.00041	42	42	43	44	45	45	„

Iso-VALERIC ACID or *iso*-PROPYLACETIC ACID $(CH_3)_2CH.CH_2.CO_2H$

Constants: B.E. (1932)

Critical temperature: 360°68 Brown (1906)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
88.2	22.891	93.82	31.087	142.25	253.443	Richardson (1886)
88.85	24.291	111.8	74.354	151.29	349.711	„
89.35	23.99	128.8	155.873	157.20	434.53	„
120.67	110.60	151.45	350.9	182.6	953.5	Landolt (1893)
139.70	235.2	161.4	500.0	188.8	1155.1	„
142.80	261.4	172.0	695.9			„

t°	p mm	t°	p mm	t°	p mm	
123.1	123.6	138.2	221.7	158.8	444.9	Schmidt (1891)
124.1	127.6	145.5	289.9	160.1	479.6	„ (dynamic method)
130.1	161.8	150.1	340.8	165.6	571.1	„
136.8	209.4	157.2	432.8	168.4	624.6	„
125.7	135.1	139.9	234.0	153.5	380.1	„ (static method)
136.1	204.1	144.8	276.4	166.1	572.3	„

Boiling point *Freezing point*

176°14	Sudborough and Davies (1909)	−29°3	Timmermans
176°5	$\frac{dt}{dp}$ *(10 mm):* 0°46 B.E. (1932) and Lecat		

Density *Viscosity* *Surface tension*

t°	d		t°	$\eta \cdot 10^5$		t°	γ	
0	0.94462		15	2731		15	25.78	B.E. (1932)
15	0.93080		30	1967		20	25.30	,,
30	0.91708					30	24.45	,,

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.40263	1.40300	1.40533	1.40929	1.41051	1.41347	1.41482
$\frac{dn}{dt}$	0.00040	41	41	45	45	46	46

METHYLETHYLACETIC ACID $CH_3.CH(C_2H_5).CO_2H$ and
TRIMETHYLACETIC ACID $C(CH_3)_3.CO_2H$: Eykman (1919)

This work appears to have been done well, but comparative data are lacking.

n-CAPROIC ACID n-$C_5H_{11}.CO_2H$

Constants: Simon (1929)

Boiling point *Freezing point*

205°15	Lecat	−3°6	Garner, Madden and Rushbrooke (1926)
205°35	Simon (1929)	−3°9	Simon (1929)
		−3°95	Deffet (1935)
		−4°25	Broughton (1934)

Melting curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²
−3.95	1	10.00	760	13.50	942
0.00	218	11.00	813	14.50	996
+5.00	487	12.50	890		

Density

t°	d		t°	d	
0	0.94428	Simon (1929)	25	0.9230	Prideaux and Coleman (1936)
15	0.93136	„	80	0.8751	Dorinson, Mc Corkle and Ralston (1942)
30	0.91832	„			

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	3525	Simon (1929)	25	27.49	Prideaux and Coleman (1936)
30	2511	„			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.41627	1.41653	1.41877	1.41878	1.42300	1.42395	1.42720	1.42836	Simon (1929)
25	1.41241	1.41272	1.41489	1.41494	1.41907	1.42015	1.42334	1.42454	„
$\frac{dn}{dt}$	0.00039	38	39	38	40	38	39	39	„
25	—	—	1.4149	—	—	—	—	—	Broughton (1934)
20.0	—	—	1.4170	—	—	—	—	—	Dorinson, Mc Corkle and Ralston (1942)
25.0	—	—	1.4150	—	—	—	—	—	
30.0	—	—	1.4132	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00038	—	—	—	—	—	„ (other temperatures see authors)

Iso-CAPROIC ACID $(CH_3)_2CH.(CH_2)_2.CO_2H$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
58.2	0.2	82.6	4.9	89.6	7.7	98.1	12.2	Kahlbaum and Schroeter (1893)
73.6	2.1	83.1	5.1	90.6	8.2	99.6	13.5	„
74.4	2.4	83.7	5.4	91.7	8.8	99.9	13.8	„
75.0	2.6	84.6	5.7	91.9	8.9	100.8	14.5	„
76.6	3.1	84.9	5.8	95.9	11.0	101.3	15.0	„
77.0	3.2	87.3	6.9	97.0	11.6	102.7	16.2	„
81.8	4.6	88.5	7.2	97.5	11.9	104.6	17.8	„

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
105.6	18.8	114.3	29.5	121.4	41.5	128.1	56.8	KAHLBAUM and SCHROETER (1893)
106.2	19.5	116.2	32.2	122.4	43.7	128.6	58.7	,,
107.9	21.1	116.7	34.1	123.0	45.1	129.3	61.1	,,
109.1	22.8	117.5	34.9	123.9	46.9	129.6	62.5	,,
110.2	23.8	118.7	37.3	125.2	50.1	130.0	62.7	,,
111.0	25.2	120.4	39.5	126.3	52.1	133.2	72.7	,,
111.8	26.2	121.1	40.9	127.3	54.9			,,
109.6	23.4	138.9	90.9	165.9	248.7	188.5	539.0	KAHLBAUM and WIRKNER (1897)
115.7	31.7	139.0	91.7	170.9	302.5	189.9	558.3	,,
117.6	35.1	141.2	99.3	174.6	341.4	192.0	599.7	,,
120.7	40.6	141.3	100.4	177.1	371.4	193.5	629.3	,,
125.4	50.4	147.2	126.6	179.6	403.3	195.4	665.6	,,
129.5	60.3	151.8	150.4	181.8	434.0	196.9	695.4	,,
132.6	70.9	153.7	162.8	184.3	471.2	199.0	742.2	,,
134.4	75.6	159.4	200.0	186.3	502.3	199.7	760.0	,,
135.8	80.3							,,

Boiling point

199°4	HOMMELEN (1933)	199°7	KAHLBAUM and WIRKNER (1897)
199°5	LECAT	199°7	FRANKE (1895)

Freezing point: −33° TIMMERMANS

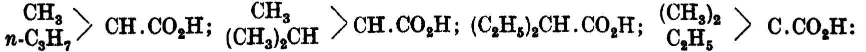
Density

t°	d	
0	0.9392	HOMMELEN (1933)
20	0.9225	,,
21.5	0.9209	EYKMAN (1919)

Refractive index

t°	Hα	D	He y.	Hβ	Hγ	
20	1.4122	1.4144	1.4144	1.4196	1.4238	HOMMELEN (1933)
21.5	1.41236	—	—	1.41962	—	EYKMAN (1919)
81.2	1.38873	—	—	1.39551	—	,,
70	1.3946	1.3967	—	1.4016	1.4055	WATERMAN and BERTRAM (1927)

ISOMERIC HEXANOIC ACIDS: $(C_2H_5.CH(CH_3).CH_2.CO_2H$; $(CH_3)_3C.CH_2.CO_2H$;



$\begin{matrix}CH_3\\ n\text{-}C_3H_7\end{matrix}\!\!>CH.CO_2H$; $\begin{matrix}CH_3\\ (CH_3)_2CH\end{matrix}\!\!>CH.CO_2H$; $(C_2H_5)_2CH.CO_2H$; $\begin{matrix}(CH_3)_2\\ C_2H_5\end{matrix}\!\!>C.CO_2H$:

Boiling, melting points, density and *refractive index;* HOMMELEN (1933).

n-HEPTANOIC ACID or OENANTHIC ACID $n\text{-}C_6H_{13}.CO_2H$

Bilterys (1935) prepared his acid by permanganic oxidation of pure freshly-distilled oenanthol.

Constants: Bilterys (1935)

Boiling point		*Freezing point*	
223°01	$\frac{dt}{dp}$ *(10 mm):* 0°45 Bilterys (1935)	−7°46	Bilterys (1935)
		−7°5	Garner, Madden and Rushbrooke (1926)

Melting curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²
−7.5	1	0.00	418	10.00	976
−5.0	141	5.00	696		

Density

t°	d		t°	d	
0	0.93454	Bilterys (1935)	30	0.90989	Bilterys (1935)
15	0.92217	„	80	0.8670	Dorinson, Mc Corkle and Ralston (1942)

Viscosity

t°	$\eta \cdot 10^5$	
15	5046	Bilterys (1935)
30	3413	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	Hγ	
15	1.42208	1.42235	—	1.42455	1.42894	1.42999	—	Bilterys (1935)
$\frac{dn}{dt}$	0.00035	35	—	35	35	35	—	„
20.0	—	—	1.4230	—	—	—	—	Dorinson, Mc Corkle
25.0	—	—	1.4209	—	—	—	—	and Ralston (1942)
30.0	—	—	1.4192	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00038	—	—	—	—	„
							(other temperatures see authors)	
70	—	1.4008	1.4029	—	—	1.4079	1.4119	Waterman and Bertram (1927)

n-CAPRYLIC ACID n-$C_7H_{15}.CO_2H$

Constants: DEFFET (1931)

Saturated vapour pressure: POOL and RALSTON (1942)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
87.5	1	109.1	4	134.6	16	165.3	64
97.9	2	121.3	8	140.2	32	183.3	128

Boiling point: 239°3 DEFFET (1931)

Freezing point

16°30	HOERR and RALSTON (1944)	16°3	BROUGHTON (1934)
16°30	POOL and RALSTON (1942)	16°3	DEFFET (1931)
16°3	HOLDE and GENTNER (1925)	16°51	HOERR, SEDGWICK and RALSTON (1946)

Melting curve

t°	p kg/cm²		t°	p kg/cm²	
16.30	1	DEFFET (1935)	30.00	669	DEFFET (1935)
20.00	190		35.00	922	„
25.00	434	„			

Density

t°	d		t°	d	
20	0.90884	DEFFET (1931)	80	0.8615	DORINSON, MC CORKLE and RALSTON (1942)
30	0.90087	„			

Viscosity

t°	$\eta \cdot 10^5$	
20	5828	DEFFET (1931)
30	4690	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
20	1.42519	1.42558	—	1.42793	1.43235	1.43338	1.43663	1.43785	Deffet (1931)
$\frac{dn}{dt}$	0.00037	37	—	38	38	37	38	—	„
20.0	—	—	1.4280	—	—	—	—	—	Dorinson, Mc Corkle and Ralston (1942)
25.0	—	—	1.4260	—	—	—	—	—	
30.0	—	—	1.4243	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00037	—	—	—	—	—	„
							(other temperatures see authors)		
70	—	1.4063	1.4085	—	—	1.4134	—	1.4176	Waterman and Bertram (1927)

n-NONOIC ACID or PELARGONIC ACID n-$C_8H_{17}.CO_2H$

Deffet (1931), Garner and Ryder (1925), Gartenmeister (1890), Waterman and Bertram (1927), Pool and Ralston (1942), Hoerr and Ralston (1944) and Dorinson, Mc Corkle and Ralston (1942) found similar but not identical data; the choice is difficult.

n-CAPRIC ACID n-$C_9H_{19}.CO_2H$

Constants

Melting point

31°	Holde and Gentner (1925)	31°35	Hoerr, Sedgwick and Ralston (1946)
31°1	Scheij (1899)		
31°24	Hoerr and Ralston (1944)	31°35	Krafft (1882)
31°3	Kahlbaum and Schroeter (1893–94)		

Density

t°	d		t°	d	
35.05	0.8884	Garner and Ryder (1925)	40	0.8858	Scheij (1899)
50.17	0.8773	„	80	0.8531	Dorinson, Mc Corkle and Ralston (1942)

Refractive index

t°	Hα	D	Hβ	Hγ	
40	—	1.42855	—	—	Scheij (1899)
60.6	—	1.4201	—	—	Holde and Gentner (1925)
40.0	—	1.4288	—	—	Dorinson, Mc Corkle and Ralston (1942)
50.0	—	1.4248	—	—	„
70	1.4149	1.4170	1.4222	1.4263	Waterman and Bertram (1927)

n-UNDECANOIC ACID $n\text{-}C_{10}H_{21}.CO_2H$

Saturated vapour pressure and *melting point;* Pool and Ralston (1942) and Hoerr and Ralston (1944); *density* and *refractive index;* Dorinson, Mc Corkle and Ralston (1942); *refractive index;* Waterman and Bertram (1927).

n-LAURIC ACID $n\text{-}C_{11}H_{23}.CO_2H$

Constants

Melting point

43°92	Hoerr and Ralston (1944)	44°	Eykman (1919)
43°92	Hoerr, Sedgwick and Ralston (1946)	44°1	Loury and Stora (1949)
44°	Holde and Gentner (1925)	44°5	Piper, Malkin and Austin (1926)

Density

t°	d		t°	d	
45.10	0.8744	Garner and Ryder (1925)	70	0.8573	Holde and Gentner (1925)
50.25	0.8707	„	80	0.8477	Dorinson, Mc Corkle and Ralston (1942)
78.5	0.8495	„	82.1	0.8475	Eykman (1893)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He bl.	He v.	Hγ	
78.5	—	1.41749	—	—	—	1.42474	—	—	—	Eykman (1893)
82.1	1.41593	1.41624	—	1.41843	1.42262	1.42363	1.42468	1.42665	1.42787	„ (1919)
45.0	—	—	1.4323	—	—	—	—	—	—	Dorinson,
50.0	—	—	1.4304	—	—	—	—	—	—	Mc Corkle and
55.0	—	—	1.4288	—	—	—	—	—	—	Ralston (1942
60.0	—	—	1.4267	—	—	—	—	—	—	„
65.0	—	—	1.4250	—	—	—	—	—	—	„
70.0	—	—	1.4230	—	—	—	—	—	—	„
80.0	—	—	1.4191	—	—	—	—	—	—	„

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
50	6877	Bingham and Fornwalt	120	1789	Bingham and Fornwalt
60	5367	„	140	1350	„ (1930)
80	3510	„ (1930)	160	1041	„
100	2457	„			

n-TRIDECANOIC ACID $n\text{-C}_{12}\text{H}_{25}\text{.CO}_2\text{H}$

Melting point, specific heat and *melting heat;* Garner, Madden and Rushbrooke (1926); *density* and *refractive index;* Dorinson, Mc Corkle and Ralston (1926).

n-MYRISTIC ACID $n\text{-C}_{13}\text{H}_{27}\text{.CO}_2\text{H}$

Constants

Melting point

53°5	Krafft (1879)	53°8	Heintz (1855)
53°6	Scheij (1899)	53°8	Krafft (1880)
53°7	Garner, Madden and Rushbrooke (1926)	53°8	Joglekar and Watson (1928)
53°7	Holde and Gentner (1925)	54°15	Hoerr and Ralston (1944) and Hoerr, Sedgwick and Ralston (1946)
53°8	Stohman, Kleber and Langbein (1889)		

Density

t°	d		t°	d	
70	0.8528	Dunstan (1915)	70	0.8533	Holde and Gentner (1925)
90	0.8394	„	80	0.8439	Dorinson, Mc Corkle and Ralston (1942)
60	0.8584	Scheij (1899)			

Surface tension

t°	γ		t°	γ	
56.8	28.6	Hunten and Maass (1929)	109.2	24.2	Hunten and Maass (1929)
60.3	28.4	„	119.2	23.6	„
66.2	27.6	„	129.2	22.7	„
74.2	27.3	„	138.3	22.0	„
76.2	27.0	„	149.3	21.3	„
89.2	25.7	„			

Refractive index

t°	D	t°	D	
55.0	1.4329	70.0	1.4273	Dorinson, Mc Corkle and Ralston (1942)
60.0	1.4310	88.0	1.4236	„
65.0	1.4291	—	—	„
60	1.43075	—	—	Scheij (1899)
70	1.4273	—	—	Holde and Gentner (1925)

n-PENTADECANOIC ACID $n\text{-}C_{14}H_{29}.CO_2H$

Melting point, specific heat and *heat of melting;* Garner, Madden and Rushbrooke (1926); *melting point;* Hoerr and Ralston (1944) and *refractive index;* Dorinson, Mc Corkle and Ralston (1942).

n-PALMITIC ACID $n\text{-}C_{15}H_{31}.CO_2H$

Constants

Melting point

62°53	Francis and Collins (1936)	62°618	De Visser (1898)
62°53	Francis, Collins and Piper (1937)	62°66	Smith (1931)
		62°67	Smith (1936)
62°6	Scheij (1899)	62°74	Guy and Smith (1939)
62°6	Broughton (1934)	62°82	Hoerr and Ralston (1944) and Hoerr, Sedgwick and Ralston (1946)
62°6	Vold, Leggett and Mac Bain (1940)		

Density

t°	d		t°	d	
70	0.8487	Dunstan (1915)	75.8	0.8463	Eykman (1893–1919)
90	0.8347	„	79.8	0.8423	„
80	0.8412	Scheij (1899)	80	0.8414	Dorinson, Mc Corkle and Ralston (1942)

Refractive index

t°	Hα	D	Hβ	Hγ	
60	—	1.4339	—	—	Pascal (1914)
70	—	1.4304	—	—	„
80	—	1.4269	—	—	
70	1.4281	1.4303	1.4358	1.4404	Waterman and Bertram (1927)
75.8	1.42719	—	1.43458	—	Eykman (1893)
80	—	1.42693	—	—	Scheij (1899)

n-MARGARIC ACID $n\text{-}C_{16}H_{33}.CO_2H$

Constants

Melting point

60°94	Hoerr, and Ralston (1944)	61°18	Smith (1936)

Density

t°	d		t°	d	
90.6	0.8355	Hunten and Maass (1929)	129.0	0.8092	Hunten and Maass (1929)
100.7	0.8282	,,	135.7	0.8039	,,
110.2	0.8213	,,	146.5	0.7961	,,

Viscosity

t°	$\eta \cdot 10^4$	
67.6	926	Hunten and Maass (1929)
76.0	747	,,
107.1	403	,,

Surface tension

t°	γ		t°	γ	
66.9	27.9	Hunten and Maass (1929)	126.1	23.8	Hunten and Maass (1929)
90.8	26.0	,,	141.0	22.5	,,
112.0	24.4	,,			

Refractive index

t°	Hα	D	Hβ	Hγ	
70	1.4296	1.4319	1.4371	1.4416	Waterman and Bertram (1927)

n-STEARIC ACID $n\text{-}C_{17}H_{35}.CO_2H$

Constants

Melting point

69°2	Scheij (1899)	69°4	Holde and Gentner (1925)
69°2	Heintz (1855)	69°41	Smith (1931)
69°3	Fisher (1939)	69°42	Smith (1936)
69°32	Francis, Collins and Piper (1937)	69°5	Loury and Stora (1949)
69°32	Hoerr and Ralston (1944)	69°60	Hoerr, Sedgwick and Ralston (1946)
69°32	De Visser (1898)		
69°35	Francis and Collins (1936)	69°60	Guy and Smith (1939)
69°35	Joglekar and Watson (1928)	69°9	Thiessen and Stüber (1938)

Density

t°	d		t°	d	
80	0.8386	Scheij (1899)	80	0.8390	Dorinson, Mc Corkle and Ralston (1942)
			80.2	0.8398	Eykman (1919)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He bl.	He v.	Hγ	
80.2	1.42744	1.42766	—	1.43000	1.43430	1.43534	1.43643	1.43848	1.43973	Eykman (1919)
80	—	—	1.4300	—	—	—	—	—	—	Whitby (1926)
80	—	—	1.43003	—	—	—	—	—	—	Scheij (1899)

n-ARACHIDIC ACID $n\text{-}C_{19}H_{39}.CO_2H$

Melting point and *heat of melting:* Garner, Madden and Rushbrooke (1926).

H. DIBASIC ACIDS

ANHYDROUS OXALIC ACID $(CO_2H)_2$

Purified by fractional crystallization from H_2O and dried *in vacuo* over P_2O_5 at 70° to 80°.

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
59.55	0.0108	79.82	0.0672	90.31	0.1645	Noyes and Wobbe (1926)
65.65	0.0183	80.50	0.0722	99.49	0.3412	„
74.40	0.0426	86.17	0.1161	105.28	0.5374	„
78.40	0.0588	86.90	0.1236			„
18.5	0.00081	32.7	0.00306	47.0	0.007805	Granovskaja (1947)

SUCCINIC ACID $CO_2H(CH_2)_2CO_2H$

Constants

Saturated vapour pressure

t°	p mm	
18.5	0.002205	Granovskaja
32.7	0.008962	„ (1947)
47.0	0.03317	„

Melting point

182°3	Phelps and Hubbard (1907)
182°7	Viseur (1926)
182°8	Mac Neight and Smyth (1936)

Specific heat: Parks and Huffman (1930)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
−179.76	0.134	−133.46	0.174	−28.86	0.262	+ 1.44	0.295
−172.26	0.141	−118.46	0.187	−13.16	0.277	10.26	0.296
−160.46	0.152	− 88.06	0.211	− 7.26	0.289	16.64	0.303
−147.66	0.162	− 58.16	0.237	− 0.76	0.344		

Heat of combustion	**18°8, (c_v) 3026.1 cal 15°/g**	**Beckers (1931)**
	20°, (c_v) 3025 „	**Keffler (1934)**
	20°, (c_v) 3025.7 „	**Roth and Becker (1937)**

SATURATED DIBASIC ACIDS from C_2 to C_{13}: *Melting point:* **Voerman** (1903–04) and **Serwy** (1933); *melting point* and *heat of combustion:* **Holleman, Van der Laan** and **Slijper** (1904), **Hartman** (1925), **Verkade, Hartman** and **Coops** Jr. (1926), **Verkade, Coops** and **Hartman** (1926) and **Verkade** and **Hartman** (1933); *melting point:* **Morrison** and **Robertson** (1949)

MALONIC ACID: *Saturated vapour pressure:* **Granovskaja** (1947).

SUBSTITUTED MALONIC ACIDS: *Heat of combustion;* **Verkade** and **Coops** (1933).

SUBSTITUTED SUCCINIC ACIDS: *Melting point* and *heat of combustion:* **Verkade, Hartman** and **Coops** (1924–26), **Verkade** and **Hartman** (1933), and **Verkade, Coops** and **Hartman** (1925–26)

GLUTARIC ACID and ADIPIC ACID: *Saturated vapour pressure:* **Granovskaja** (1947)

METHYL and DIMETHYLGLUTARIC ACIDS: *Rotatory power:* **Fredga** (1947)

I. UNSATURATED ACIDS

Eykman (1919) has studied the density and the refractive index of the following acids:

ACRYLIC ACID	$CH_2{=}CH.CO_2H$ (B.P.) 140°5 **Lecat** (passim)
DIMETHYLACRYLIC ACID	$(CH_3)_2C{=}CH.CO_2H$
TIGLIC and ANGELIC ACIDS	$CH_3.CH{=}C(CH_3)CO_2H$
TRIMETHYLACRYLIC ACID	$(CH_3)_2C{=}C(CH_3)CO_2H$
PROPYL-ETHYLACRYLIC ACID	$(C_3H_7)CH{=}C(C_2H_5)CO_2H$
CROTONIC ACID	$CH_3.CH{=}CH.CO_2H$
ALLYL-ACETIC ACID	$CH_2{=}CH(CH_2)_2.CO_2H$
HEPTENOIC ACID	$CH_2{=}CH(CH_2)_4.CO_2H$
OCTENOIC ACID	$CH_3.CH{=}C(C_2H_5).CH(CH_3).CO_2H$
UNDECENOIC ACID	$CH_2{=}CH(CH_2)_8.CO_2H$
STEARENIC ACID	$CH_2{=}CH(CH_2)_{15}.CO_2H$
ELAIDIC ACID	$CH_3(CH_2)_7.CH{=}CH(CH_2)_7.CO_2H$
ERUCIC ACID	$CH_3(CH_2)_7.CH{=}CH(CH_2)_{11}.CO_2H$

OLEIC ACID $CH_3.(CH_2)_7.CH{=}CH(CH_2)_7.CO_2H$

Constants

Melting point: 16° **Bertram** (1927)

Density

t°	d		t°	d	
15	0.8939	**Keffler** and **Mac Lean**	30	0.8835	**Keffler** and **Mac Lean**
20	0.8905	„ (1935)	60	0.8634	„ (1935)
25	0.8870	„	90	0.8429	„

Viscosity

t°	$\eta \cdot 10^4$		t°	$\eta \cdot 10^4$	
20	3880	KEFFLER and MAC LEAN	45	1408	KEFFLER and MAC LEAN
25	2764	„ (1935)	60	941	„ (1935)
30	2301	„	80	485	„
35	1946	„			

Refractive index

$n_D^{20°}$	1.45823	BERTRAM (1927)
$n_D^{70°}$	1.44179	„

Heat of combustion	20°, (c_v) 9438.2 cal. 15°/g	KEFFLER (1935)

RICINOLEIC ACID $CH_3(CH_2)_5.CH(OH).CH_2.CH{=}CH(CH_2)_7CO_2H$

Constants: ANDRE and VERNIER (1932)

Density *Viscosity*

t°	d	t°	d	t°	η	t°	η
23.6	0.9439	76.0	0.9090	23.6	3.848	76.2	0.2480
36.9	0.9352	99.7	0.8927	37.4	1.633	100	0.1106
51.7	0.9254			51.7	0.7321		

Refractive index

t°	n_D	t°	n_D
15	1.4732	36	1.46585
20	1.47145	45	1.4627
26	1.46935	53	1.4598

Rotatory power $[\alpha]_D^{23°}$: +7.28

MALEIC ACID *(cis)* $CO_2H.CH{=}CH.CO_2H$ FUMARIC ACID *(trans)*

Specific heat: Parks and Huffman (1930)

J. ESTERS

Method of purification

By shaking with calcined Na_2CO_3; drying over Na_2CO_3 and, in order to remove the alcohol, distillating over P_2O_5, with which the esters form a gel, followed by fractional distillation.

METHYL FORMATE $H.CO_2CH_3$

Constants: B.E. (1930). — **Polyphasic equilibria**

Critcal constants

t° cr	p cr. mm	d cr.	
214.0	45030	0.3489	Young (1910)

Densities of the liquid and the saturated vapour

t°	L.	V.	t°	L.	V.	t°	L.	V.	
0	1.00319	0.0007	90	0.8634	0.01350	180	0.6521	0.09434	Young (1910)
10	0.9889	0.0011	100	0.8452	0.01723	190	0.6148	0.1178	„
20	0.9745	0.0016	110	0.8264	0.02160	200	0.5658	0.1524	„
30	0.9598	0.002291	120	0.8070	0.02688	206	0.5241	0.1862	„
40	0.9447	0.003236	130	0.7860	0.03344	210	0.4857	0.2188	„
50	0.9294	0.004456	140	0.7638	0.04124	212	0.4549	0.2451	„
60	0.9133	0.006039	150	0.7403	0.05063	213	0.4328	0.2681	„
70	0.8968	0.008032	160	0.7136	0.06231	213.5	0.4157	0.2865	„
80	0.8803	0.01049	170	0.6844	0.07634	214	0.3489	0.3489	„

Rectilinear diameter: $0.5020 - 0.0007013\,t° - 0.0000000665\,t°^2$ Young (1910)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
−10	117.65	60	1991	130	11105	200	36685	Young (1910)
0	195.00	70	2673	140	13570	206	40085	„
10	309.40	80	3508	150	16330	210	42510	„
20	476.40	90	4524	160	19500	212	43755	„
30	707.90	100	5774	170	23015	213	44410	„
40	1029	110	7278	180	27040	213.5	44670	„
50	1452	120	9016	190	31550	214	45030	„

Boiling point

31°50	B.E. (1930)	31°78	Thorpe and Rodger (1897)
31°7	Lecat (passim)	31°80	Young and Thomas (1893)
31°77	Eykman (1919)	31°9	Young (1910)

$\frac{dt}{dp}$ *(10 mm)*

0°34	Timmermans (1910)	0°35	B.E. (1930) and Lecat (passim)
0°34	Eykman (1919)		

Freezing point: — 99°0 Timmermans

Constants of state

Density

t°	d		t°	d	
0	1.00317	B.E. (1930)	0	1.00320	(sample A) Young and Thomas
10	0.98864	,,	11.55	0.98674	,, (1893)
15	0.98149	,,	0	1.00318	(sample B) ,,
20	0.97421	,,	12.65	0.98520	,,

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0.58	426.3	Thorpe and Rodger	25.52	329.8	Thorpe and Rodger
6.39	399.9	,, (1897)	29.26	319.0	,, (1897)
10.88	381.0	,,			
15.64	362.6	,,	15	360	B.E. (1930)
20.15	346.7	,,	25	328	,,

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.34426	1.34465	1.34648	1.34995	1.35073	1.35339	1.35420
$\frac{dn}{dt}$	0.00043	43	44	44	44	44	44

ETHYL FORMATE $H.CO_2C_2H_5$

Constants: B.E. (1932). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
235.3	35535	0.3232	Young (1910)

Densities of the liquid and the saturated vapour

t°	L.	V.	t°	L.	V.	t°	L.	V.	
0	0.94802	0.0003	100	0.8112	0.01032	200	0.6066	0.08621	Young (1910)
10	0.9346	0.0005	110	0.7955	0.01312	210	0.5724	0.1073	,,
20	0.9226	0.0008	120	0.7796	0.01657	220	0.5290	0.1379	,,
30	0.9094	0.0012	130	0.7628	0.02073	225	0.5014	0.1587	,,
40	0.8963	0.0017	140	0.7448	0.02564	230	0.4635	0.1890	,,
50	0.8827	0.002438	150	0.7257	0.03164	233	0.4281	0.2198	,,
60	0.8689	0.003370	160	0.7058	0.03876	234	0.4117	0.2353	,,
70	0.8552	0.004570	170	0.6843	0.04739	235.3	0.3232	0.3232	,,
80	0.8409	0.006098	180	0.6610	0.05747				,,
90	0.8262	0.007994	190	0.6355	0.07018				,,

Rectilinear diameter: 0.4741 — 0.0006251 t° — 0.0000000694 $t^{\circ 2}$ Young (1910)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
−20	22.49	50	649.4	130	5954	190	18052	Young (1910)
−10	41.50	60	921.5	140	7360	200	21148	,,
0	72.44	80	1706	150	8954	210	24601	,,
10	120.35	90	2265	160	10847	220	28527	,,
20	192.55	100	2950	170	12963	230	32968	,,
30	297.50	110	3782	180	15358	235.3	35535	,,
40	446.7	120	4778					,,
29.6	291	38.2	419	44.9	541	53.1	730	Schumann (1881)
33.2	342	41.5	477	49.4	638	56.4	814	,,

Boiling point

54°15	$\frac{dt}{dp}$ *(10 mm):* 0°37	B.E. (1932)
54°15	,, 0°36	Lecat
54°2		Perkin (1884–85)
54°2		Brown (1903)
54°25		Thorpe and Rodger (1897)
54°3	,, 0°37	Young and Thomas (1893)

Freezing point: −79°4

Density

t°	d		t°	d	
0	0.94815	B.E. (1932)	0	0.94807	(sample A) YOUNG and THOMAS
15	0.92892	,,	12.15	0.93273	,, ,, (1893)
30	0.90958	,,	0	0.94796	(sample) B) ,,
			13.5	0.93108	,, ,,
20	0.9226	LOWRY (1914)	15	0.92906	PERKIN (1884)
			25	0.91608	,,

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0.46	502.4	THORPE and RODGER	43.37	317.8	THORPE and RODGER
6.57	465.6	,, (1897)	48.62	303.1	,, (1897)
11.52	440.9	,,	52.03	294.2	,,
16.58	417.1	,,			
22.59	391.0	,,	15	419	B.E. (1932)
27.90	369.8	,,	30	358	,,
33.25	350.1	,,	25	379	DUNSTAN, THOLE and
38.09	334.4	,,			BENSON (1914)

Surface tension

t°	γ	
15	24.37	B.E. (1932)
20	23.84	,,
30	22.38	,,

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.36021	1.36047	1.36253	1.36610	1.36685	1.36907	1.37087
$\frac{dn}{dt}$	0.00044	44	44	45	45	45	47

Magnetic rotatory power: 18°8 0.8023 PERKIN (1884)

Heat of vaporisation. The heats of vaporisation given by BROWN (1906) and by MARSHALL and RAMSAY (1896) are incompatible, as also for the following esters.

n-PROPYL FORMATE $H.CO_2n\text{-}C_3H_7$

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. mm	d cr.	
264.85	30460	0.3093	Young (1910)

Densities of the liquid and saturated vapour

t°	L.	V.	t°	L.	V.	t°	L.	V.	
0	0.92868	0.0001	90	0.8214	0.004107	180	0.6873	0.03236	Young (1910)
10	0.9173	0.0001	100	0.8080	0.005432	190	0.6691	0.03891	,,
20	0.9058	0.0003	110	0.7947	0.007047	200	0.6487	0.04717	,,
30	0.8943	0.0006	120	0.7811	0.009033	210	0.6259	0.05698	,,
40	0.8827	0.0008	130	0.7670	0.01140	220	0.6024	0.06897	,,
50	0.8708	0.0011	140	0.7523	0.01422	230	0.5757	0.08403	,,
60	0.8588	0.0016	150	0.7369	0.01770	240	0.5438	0.1045	,,
70	0.8486	0.002227	160	0.7209	0.02179	250	0.5025	0.1340	,,
80	0.8341	0.003040	170	0.7045	0.02667	260	0.4404	0.1848	,,

Rectilinear diameter: 0.4647 — 0.0005748 t° — 0.0000000459 t°^{2} Young (1910)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
−10	11.40	70	523.9	140	3676	210	13575	Young (1910)
0	21.40	80	734.5	150	4558	220	15870	,,
10	37.85	90	1004	160	5605	230	18465	,,
20	63.9	100	1345	170	6797	240	21425	,,
30	104.1	110	1770	180	8177	250	24693	,,
40	163.6	120	2288	190	9734	260	28520	,,
50	249.4	130	2915	200	11560	264.85	30460	,,
60	364.9							,,

Boiling point

80°85	$\frac{dt}{dp}$ *(10 mm)*: 0°40	LECAT
80°89		THORPE and RODGER (1897)
80°9	„ 0°40	YOUNG and THOMAS (1893)
80°9		YOUNG (1910)

Freezing point: −92°9 TIMMERMANS

Constants of state

Density

t°	d		t°	d	
0	0.92866	(sample A)	0	0.92870	(sample B) YOUNG and THOMAS
16.65	0.90950	„	13.70	0.91305	„ (1893)
			13.5	0.91290	EYKMAN (1919)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
0.35	664.8	30.77	455.7	61.56	331.5	THORPE and RODGER
7.34	604.1	38.54	418.5	67.13	313.1	„ (1897)
15.54	545.8	45.73	387.6	74.99	292.8	„
23.16	497.5	54.15	356.4	77.55	286.1	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He bl.	He v.	Hγ	
13.5	1.37828	1.37855	1.38050	1.38424	1.38514	1.38610	1.38789	1.38898	EYKMAN (1919)

The butyl and amyl formates have never been studied with sufficient accuracy.

Constants		*n*-HEXYL FORMATE $H.CO_2n\text{-}C_6H_{13}$		*n*-HEPTYL FORMATE $H.CO_2n\text{-}C_7H_{15}$		*n*-OCTYL FORMATE $H.CO_2n\text{-}C_8H_{17}$	
		BILTERYS (1935)		BILTERYS (1935)		GISSELEIRE (1935)	
Boiling point:		155°51		178°12		198°80	
$\frac{dt}{dp}$ *(10 mm)*		0°48		—		0°39	
Freezing point:		−62°65		−46°4 TIMMERMANS		−39°1	
Density:	0°	0.89959		0.89587		0.89123	
	15°	0.88590		0.88277		0.87859	
	30°	0.87219		0.86968		0.86587	
Viscosity: $\eta \cdot 10^5$	15°	1115		1366		1750	
	30°	879		1063		1318	
Surface tension:	15°	—		—		28.92	
	20°	—		—		28.30	
	30°	—				27.05	
Refractive index:	15°		$\frac{dn}{dt}$		$\frac{dn}{dt}$		$\frac{dn}{dt}$
	He r.	1.40638	0.00040	1.41252	0.00040	1.41813	0.00039
	Hα	1.40690	40	1.41289	40	1.41850	39
	He y.	1.40898	41	1.41505	40	1.42082	40
	He g.	1.41320	42	1.41924	41	1.42494	39
	Hβ	1.41413	42	1.42032	45	1.42599	39

sec. β-OCTYL FORMATE	$H.CO_2C_8H_{17}$	PICKARD, KENYON and HUNTER (1923)
sec. γ-NONYL FORMATE	$H.CO_2C_9H_{19}$	

METHYL ACETATE $CH_3.CO_2CH_3$

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. mm	d cr.	
233.7	35212	0.3252	YOUNG (1910)

Densities of the liquid and saturated vapour

t°	L.	V.	t°	L.	V.	t°	L.	V.	
0	0.95932	0.0003	100	0.8221	0.009671	200	0.6100	0.08658	**Young** (1910)
10	0.9465	0.0005	110	0.8060	0.01239	210	0.5741	0.1091	„
20	0.9338	0.0007	120	0.7893	0.01570	220	0.5281	0.1416	„
30	0.9208	0.0010	130	0.7715	0.01970	227	0.4818	0.1776	„
40	0.9075	0.0015	140	0.7532	0.02454	230	0.4257	0.2028	„
50	0.8939	0.002212	150	0.7339	0.03026	232	0.4226	0.2288	„
60	0.8800	0.003076	160	0.7133	0.03731	233	0.3995	0.2525	„
70	0.8662	0.004193	170	0.6907	0.04598	233.7	0.3252	0.3252	„
80	0.8519	0.005618	180	0.6671	0.05682				„
90	0.8374	0.007440	190	0.6410	0.06993				„

Rectilinear diameter: $0.4799 - 0.0006280\, t^\circ - 0.0000001467\, t^{\circ 2}$ **Young** (1910)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
−20	19.05	50	588.15	130	5725	200	21085	**Young** (1910)
−10	35.15	60	837.50	140	7100	210	24649	„
0	62.10	80	1585	150	8702	220	28705	„
10	104.85	90	2114	160	10566	230	33358	„
20	169.80	100	2778	170	12692	232	34334	„
30	265.75	110	3584	180	15118	233.7	35212	„
40	400.40	120	4556	190	17941			„

t°	p mm		t°	p mm	
30	270	**Schmidt** (1926)	39.76	401.3	**Bredig** and **Bayer** (1927)
40	405	„	49.76	589.4	„
80	1588	„			

Boiling point

56°95	$\frac{dt}{dp}$ *(10 mm):* 0°37	**Lecat**
57°09		**Thorpe** and **Rodger** (1897)
57°1	$\frac{dt}{dp}$ *(10 mm):* 0°37	**Young** and **Thomas** (1893)
57°15		**Young** (1910)
57°2		**Chadwell** (1926)
57°25		**Schmidt** (1891)
57°323	„ 0°375	**Wojciechowski** and **Smith** (1937)

Constants of state

Density

t°	d		t°	d	
0	0.95934	(sample A)	0	0.95929	(sample B) YOUNG and THOMAS
14.45	0.94097	„	14.27	0.94110	„ (1893)
20	0.93347	CHADWELL (1925)			
25	0.92740	„ (1926)	25	0.9273	WOJCIECHOWSKI and SMITH (1937)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
0.34	476.2	22.75	370.6	46.06	294.3	THORPE and RODGER
6.31	443.6	28.38	349.2	50.34	282.9	„ (1897)
11.41	418.6	33.86	330.4	54.33	272.7	„
16.71	393.8	40.45	310.0			„
19.5	386	56.7	267	80.4	217	TITANI (1927)
20.3	382	60.3	258	110.2	167	„
34.5	328	65.0	249	139.0	132	„
46.1	294					„

Refractive index

λ	2747	3025	3101	3195	3307	3491	3560	3975	
20°	1.3985	1.3887	1.3866	1.3843	1.3819	1.3785	1.3773	1.3725	EVANS and EVANS (1929)
λ	4713	5016	5461	5876	5893	6678	—	—	„
16°8	1.3685	1.3678	1.3663	1.3643	1.3639	1.3622	—	—	„

Heat constants

Heat of vaporization	(B.P). 97.0 cal 15°/g	MARSHALL and RAMSAY (1896)
Heat of combustion	18°5 → 20° (c_v) 5139.8 „	SCHJÄNBERG (1934)

ETHYL ACETATE $CH_3.CO_2C_2H_5$

Water, ethyl alcohol and acetic acid may be detected down to a concentration of 4.10^{-3} % (Gillo, 1938). This author concludes that it is impossible to obtain a sample of very great purity owing to decomposition of the product, even when kept *in vacuo*, in sealed tubes and in the dark. Furthermore, this compound is very hygroscopic. It is impossible to attain more than the fourth degree of purity, that is: $\Delta t = 0°007$ (see Wojciechowski).

Constants: B.E. (1930). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
250.1	28878	0.3077	Young (1910)

Densities of the liquid and saturated vapour

t°	L.	V.	t°	L.	V.	t°	L.	V.	
0	0.92436	0.0001	100	0.7972	0.006158	200	0.6210	0.05797	
10	0.9127	0.0002	110	0.7831	0.008006	210	0.5944	0.07128	Young (1910)
20	0.9005	0.0003	120	0.7683	0.01030	220	0.5648	0.08905	,,
30	0.8885	0.0005	130	0.7533	0.01314	230	0.5281	0.1131	,,
40	0.8762	0.0008	140	0.7378	0.01650	240	0.4778	0.1499	,,
50	0.8636	0.0012	150	0.7210	0.02070	245	0.4401	0.1802	,,
60	0.8508	0.0018	160	0.7033	0.02577	247	0.4195	0.1996	,,
70	0.8376	0.002561	170	0.6848	0.03165	249	0.3839	0.2288	,,
80	0.8245	0.003495	180	0.6653	0.03883	250.1	0.3077	0.3077	,,
90	0.8112	0.004677	190	0.6441	0.04751				,,

Rectilinear diameter: $0.4624 - 0.0005992\, t° - 0.0000000764\, t^{\circ 2}$ Young (1910)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
−20	6.55	60	415.4	140	4166	220	18255	Young (1910)
−10	12.95	70	596.3	150	5168	230	21270	,,
0	24.30	80	832.7	160	6369	240	24807	,,
10	42.7	90	1130	170	7742	245	26740	,,
20	72.8	100	1517	180	9318	247	27535	,,
30	118.7	110	2001.5	190	11125	249	28370	,,
40	186.2	120	2586	200	13200	250	28800	,,
50	282.2	130	3298	210	15565	250.1	28877	,,
49.99	280.5	—	—	—	—	—	—	Zawidzki (1900)

Boiling point

77°1	$\frac{dt}{dp}$ *(10 mm)*: 0°41	Lecat
77°10		Tyrer (1912)
77°112	„ 0°401	Wojciechowski and Smith (1937)
77°15		Tyrer (1914)
77°15	„ 0°41	Timmermans (1910–12)
77°15	„ 0°41	B.E. (1930)
77°15	„ 0°40	Young and Thomas (1893) and Young (1910)
77°15		Chadwell (1926)
77°15		Wade and Merriman (1912)
77°15		Grimm and Patrick (1923)
77°15		Gilman and Gross (1938)
77°18		Thorpe and Rodger (1897)
77°18		Young and Fortey (1903)

Freezing point: −83°6 Timmermans, Van der Horst and Kamerlingh Onnes (1922)

Constants of state

Density

t°	d		t°	d	
+16.0	0.90550	Timmermans (1912)	0	0.92454	Wade and Merriman (1912)
0	0.92450	„	5	0.91865	„
− 6.2	0.93199	„	10	0.91268	„
−13.1	0.94024	„	15	0.90665	„
−22.95	0.95187	„	20	0.90056	„
−30.6	0.96088	„	25	0.89446	„
−35.3	0.96646	„	30	0.88830	„
−37.2	0.96859	„	35	0.88214	„
−45.0	0.97778	„	40	0.87598	„
−53.6	0.98772	„			
−63.3	0.99897	„			
−73.95	1.01128	„			
−83.4	1.02220	„			
0	0.92453	B.E. (1930)	15	0.90545	Perkin (1885)
15	0.90657	„	25	0.89450	„
30	0.88851	„	0	0.92446	Young and Fortey (1903)
0	0.92434	(samp. B) Young and Thomas (1893)	25	0.89451	Chadwell (1926)
			25	0.89468	Wojciechowski and Smith (1937)
19.9	0.90070	„ „			
0	0.92438	(samp. A) „	25	0.8947	Peacock (1915)
18.15	0.90286	„ „			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0.25	576.3	THORPE and RODGER	51.15	322.4	THORPE and RODGER
8.90	514.4	„ (1897)	60.17	296.0	„ (1897)
14.46	479.5	„	68.43	274.2	„
21.38	441.8	„	74.60	259.4	„
28.12	409.6	„	15	473	B.E. (1930)
36.54	373.8	„	30	400	„
44.12	345.5	„	25	424.4	CHADWELL (1926)

Surface tension

t°	γ	
15	24.36	B.E. (1930) and HENNAUT-ROLAND and LEK (1931)
20	23.75	„
30	22.55	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.37281	1.37306	—	1.37510	1.37868	1.37962	1.38240	1.38342	B.E. (1930)
$\frac{dn}{dt} \cdot$	0.00048	48	—	49	49	49	51	51	„
20	—	—	1.37243	—	—	—	—	—	FISCHER and ZERBE (1923)
25.2	—	—	1.37012	—	—	—	—	—	ZAWIDZKI (1900)

Heat constants

Specific heat: PARKS, HUFFMAN and BARMORE (1933)

t°	c_p	t°	c_p	t°	c_p
C. −180.96	0.199	−164.66	0.219	−127.86	0.257
−176.66	0.205	−158.96	0.225	−121.26	0.263
−176.06	0.206	−147.96	0.237	−117.16	0.269
−170.86	0.213	−142.16	0.243	−113.26	0.275
−169.16	0.214	−137.06	0.248	−105.86	0.285
L. −77.46	0.435	− 28.66	0.438	15.54	0.456
−68.06	0.434	− 14.86	0.443	20.44	0.459
−47.96	0.435	+ 1.74	0.450		

Heat of melting	28.43 cal 15°/g	PARKS, HUFFMAN and BARMORE (1933)
Heat of combustion	18°5 → 20°, (c_v) 6070.5 „	SCHJÄNBERG (1935)

n-PROPYL ACETATE $CH_3.CO_2n\text{-}C_3H_7$

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. mm	d cr.	
276.2	25227	0.2957	Young (1910)

Densities of the liquid and the saturated vapour: Young (1910)

t°	L.	V.	t°	L.	V.	t°	L.	V.	
0	0.91016	0.00004	110	0.7830	0.004405	220	0.5987	0.05025	Young (1910)
10	0.8993	0.0001	120	0.7702	0.005760	230	0.5855	0.06154	„
20	0.8884	0.0002	130	0.7571	0.007440	240	0.5586	0.07576	„
30	0.8773	0.0003	140	0.7435	0.009497	250	0.5289	0.09390	„
40	0.8663	0.0004	150	0.7297	0.01195	260	0.4908	0.1205	„
50	0.8551	0.0006	160	0.7149	0.01489	266	0.4611	0.1445	„
60	0.8435	0.0009	170	0.6997	0.01848	270	0.4333	0.1661	„
70	0.8320	0.0012	180	0.6835	0.02268	273	0.4063	0.1912	„
80	0.8201	0.0017	190	0.6667	0.02778	275	0.3769	0.2169	„
90	0.8079	0.002457	200	0.6488	0.03390	276.2	0.2957	0.2957	„
100	0.7957	0.003328	210	0.6301	0.04115				„

Rectilinear diameter: 0.4553 — 0.0005469 t° — 0.0000001124 t°² Young (1910)

Saturated vapour pressure:

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
0	7.4	80	372.8	160	3441	240	14675	Young (1910)
10	13.9	90	524.8	170	4269	250	17090	„
20	25.1	100	723.6	180	5189	260	19855	„
30	42.7	110	976.0	190	6275	266	21685	„
40	70.8	120	1293	200	7543	270	22980	„
50	112.2	130	1685	210	8973	273	24060	„
60	171.8	140	2171	220	10620	275	24750	„
70	257.3	150	2747	230	12505	276.2	25227	„

Boiling point

101°545	$\frac{dt}{dp}$ *(10 mm):* 0°430	Wojciechowski and Smith (1937)
101°55	„ 0°43	Young and Thomas (1893) and Young (1910)
101°6		Lecat (passim)

Freezing point: —95° Timmermans

Constants of state

Density

t°	d		t°	d	
0	0.91015	(sample A)	0	0.91017	(sample B) YOUNG and THOMAS
17.6	0.89082	„	15.95	0.89269	„ (1893)
			25	0.88303	WOJCIECHOWSKI and SMITH (1937)

Iso-PROPYL ACETATE $CH_3CO_2CH(CH_3)_2$

Saturated vapour pressure: HAGGERTY and WEILER (1929); *boiling point, density* and *viscosity:* SWARTS (1929); *refractive index* and *heat of combustion:* SCHJÄNBERG (1934).

n-BUTYL ACETATE $CH_3.CO_2\,n\text{-}C_4H_9$

Constants

Boiling point

126°0		LECAT
126°103	$\frac{dt}{dp}$ *(10 mm):* 0°456	WOJCIECHOWSKI and SMITH (1937)
126°2		HANNOTTE (1926)

Freezing point: –73°5 TIMMERMANS

Density

t°	d	
0	0.9015	GARTENMEISTER (1886)
0	0.9015	HANNOTTE (1926)
25	0.87636	WOJCIECHOWSKI and SMITH (1937)

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.39464	1.39614	1.40146	1.40539	HANNOTTE (1926)

Heat of combustion	18°5 → 20° (c_v) 7294.4 cal 15°/g	SCHJÄNBERG (1934)

There are no reliable data for *n*-AMYLACETATE.

		n-HEXYL ACETATE $CH_3.CO_2n\text{-}C_6H_{13}$		*n*-HEPTYL ACETATE $CH_3.CO_2n\text{-}C_7H_{15}$	
Constants		Gisseleire (1935)		Bilterys (1935)	
Boiling point:		171°48 171°5 Lecat		192°45	
$\frac{dt}{dp}$ *(10 mm):*		0°49		0°52	
Freezing point:		−60°9		−50°2	
Density:	0°	0.89147		0.88811	
	15°	0.87791		0.87505	
	30°	0.86427		0.86199	
Viscosity $\eta \cdot 10^5$:	15°	1254		1598	
	30°	968		1216	
Surface tension:	15°	26.99		—	
	20°	26.34		—	
	30°	25.14		—	
Refractive index: 15°			$\frac{dn}{dt}$		$\frac{dn}{dt}$
	He r.	1.40857	0.00041	1.41398	0.00041
	Hα	1.40905	41	1.41430	41
	He y.	1.41122	40	1.41653	41
	He g.	1.41508	40	1.42069	41
	Hβ	1.41626	40	1.42170	41

n-OCTYL ACETATE: $CH_3.CO_2n\text{-}C_8H_{17}$: *boiling point, density* and *refractive index;* Eykman (1919).

sec.-OCTYL and *sec.*-DECYL ACETATES: $CH_3.CO_2\,sec.\text{-}C_8H_{17}$ and $CH_3.CO_2\,sec.\text{-}C_{10}H_{21}$: Patterson and Holmes (1936).

n-NONYL, DECYL, UNDECYL, DODECYL and TRIDECYL ACETATES: $CH_3.CO_2$ $n\text{-}C_9H_{19}$, $C_{10}H_{21}$, $C_{11}H_{23}$, $C_{12}H_{25}$ and $C_{13}H_{27}$: *freezing point* and *polymorphism;* Van Bellinghen (1938)

sec-BUTYL, HEXYL, HEPTYL, OCTYL, NONYL, DECYL, UNDECYL, TRIDECYL ACETATES: $CH_3.CO_2$ *sec.*-C_4H_9, C_6H_{13}, C_7H_{15}, C_8H_{17}, C_9H_{19}, $C_{10}H_{21}$, $C_{11}H_{23}$, $C_{13}H_{27}$: Pickard and Kenyon (1914).

n-CETYL ACETATE $CH_3.CO_2n\text{-}C_{16}H_{33}$

Constants

Melting point: 18°5 PERKIN (1884–'85)

Density

t°	d	
21	0.86234	PERKIN (1884-85)
25	0.85868	,,
33.9	0.8504	EYKMAN (1919)

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He bl.	He v.	Hγ	
33.9	1.43333	1.43364	1.43591	1.44023	1.44129	1.44239	1.44444	1.44569	EYKMAN (1919)

Specific magnetic rotatory power: 20°7 1.0283 PERKIN (1884–85)

VINYL ACETATE $CH_3.CO_2CH{=}CH_2$

Density and *surface tension;* GREEN, MARSDEN and CUTHBERTSON (1933).

METHYL PROPIONATE $C_2H_5.CO_2CH_3$

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. mm	d cr.	
257.4	30032	0.3124	YOUNG (1910)

Densities of the liquid and saturated vapour:

t°	L.	V.	t°	L.	V.	t°	L.	V.	
0	0.93871	0.0001	110	0.7996	0.007446	210	0.6207	0.06390	YOUNG (1910)
10	0.9268	0.0002	120	0.7852	0.009569	220	0.5938	0.07812	,,
20	0.9151	0.0003	130	0.7705	0.01214	230	0.5635	0.09662	,,
30	0.9032	0.0005	140	0.7553	0.01529	240	0.5220	0.1236	,,
40	0.8912	0.0007	150	0.7390	0.01905	245	0.4976	0.1418	,,
50	0.8790	0.0011	160	0.7221	0.02356	250	0.4655	0.1675	,,
60	0.8665	0.0016	170	0.7045	0.02907	253	0.4401	0.1890	,,
70	0.8537	0.002331	180	0.6856	0.03552	255	0.4151	0.2118	,,
80	0.8408	0.003199	190	0.6657	0.04320	256	0.3892	0.2294	,,
90	0.8273	0.004301	200	0.6445	0.05236	257.4	0.3124	0.3124	,,
100	0.8137	0.005714							,,

Rectilinear diameter: $0.4696 - 0.0005921\ t° - 0.0000000729\ t°^2$ YOUNG (1910)

Saturated vapour pressure:

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
−10	11.55	70	548.0	150	4830	230	20000	Young (1910)
0	21.9	80	771.0	160	5957	240	23325	„
10	38.85	90	1045.0	170	7245	245	25115	„
20	66.2	100	1406	180	8737	250	26997	„
30	107.8	110	1854	190	10420	263	28205	„
40	169.3	120	2406	200	12380	255	29055	„
50	256.7	130	3071	210	14625	256	29445	„
60	380.3	140	3888	220	17160	257.4	30032	„

Boiling point

79°65 and 79°70	Young and Thomas (1893) and Young (1910)
79°70	Thorpe and Rodger (1897)
79°85	Lecat

Freezing point: −87°5 Timmermans

Constants of state

Density

t°	d		t°	d	
0	0.93871	Young (1910)	9.13	0.9278	Prytz (1880)
10	0.9268	„	20	0.9148	Schjänberg (1934)
20	0.9151	„	0	0.93874	(sample A) Young and Thomas
30	0.9032	„	18.5	0.91700	„ „ (1893)
			0	0.93868	(sample B) „
			16.4	0.91945	„ „

Viscosity: Thorpe and Roger (1897)

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$
0.38	578.8	29.62	409.8	60.38	302.8
9.73	514.2	38.66	374.6	68.47	281.1
16.79	472.5	45.59	347.7	75.85	263.7
23.45	436.8	52.66	325.5		

Refractive index

t°	Hα	D	Hβ	Hγ	
9.7	—	1.3823	—	—	Prytz (1880)
20	1.37516	1.3775	1.38132	1.38482	Schjänberg (1934)

Heat constant

Heat of combustion	18°5 → 20° (c_v) 6091.5 cal 15°/g	Schjänberg (1934)

ETHYL PROPIONATE $C_2H_5.CO_2C_2H_5$

Constants: B.E. (1930). — **Polyphasic equilibria**

Critical constants

t° cr.	p cr. mm	d cr.	
272.9	25217	0.2965	Young (1910)

Densities of the liquid and saturated vapour:

t°	L.	V.	t°	L.	V.	t°	L.	V.	
0	0.9124	0.00005	110	0.7823	0.004748	210	0.6243	0.04464	Young (1910)
10	0.9011	0.0001	120	0.7692	0.00620	220	0.6027	0.05435	,,
20	0.8901	0.0002	130	0.7548	0.00800	230	0.5784	0.06667	,,
30	0.8791	0.0003	140	0.7413	0.01024	240	0.5501	0.08230	,,
40	0.8672	0.0004	150	0.7267	0.01292	250	0.5181	0.1030	,,
50	0.8557	0.0006	160	0.7115	0.01615	260	0.4744	0.1337	,,
60	0.8440	0.0009	170	0.6958	0.02004	265	0.4459	0.1562	,,
70	0.8320	0.0013	180	0.6795	0.02469	268	0.4227	0.1751	,,
80	0.8201	0.0019	190	0.6625	0.03012	270	0.4018	0.1957	,,
90	0.8077	0.002674	200	0.6443	0.03676	272.9	0.2965	0.2965	,,
100	0.7951	0.003580							,,

Rectilinear diameter: 0.4564 — 0.0005644 t° — 0.0000000784 $t^{\circ 2}$ Young (1910)

Saturated vapour pressure:

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
0	8.30	80	403.6	160	3657	240	15425	Young (1910)
10	15.55	90	569.5	170	4505	250	17970	„
20	27.75	100	785.0	180	5487	260	20825	„
30	47.75	110	1048	190	6619	265	22400	„
40	77.90	120	1386	200	7934	268	23415	„
50	123.0	130	1801	210	9456	270	24105	„
60	188.0	140	2316	220	11195	272.9	25217	„
70	279.9	150	2920	230	13145			„

Boiling point:

99°0	$\frac{dt}{dp}$ *(10 mm):* 0°43 Young and Thomas (1893) and Young (1910)
99°10	„ 0°42 B.E. (1930) and Lecat (passim)
99°2	Brown (1903)

Freezing point: −73°85 Timmermans

Constants of state

Density

t°	d		t°	d	
0	0.91251	B.E. (1930)	0	0.91251	Young and Fortey (1903)
15	0.89574	„	0	0.91245	Timmermans (1910–12)
30	0.87903	„	0	0.91238	Elsässer (1883)
0	0.91238	(sample A) Young and Thomas (1893)			
16.65	0.89376	„ „			
0	0.91242	(sample B) „			
17.7	0.89259	„ „			

Viscosity. *Surface tension*

t°	$\eta \cdot 10^5$	t°	γ	
15	564	15	24.83	B.E. (1930) and Hennaut-Roland and Lek (1931)
30	473	20	24.27	„
		30	23.16	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.38401	1.38442	1.38643	1.39017	1.39109	1.39402	1.39504
$\frac{dn}{dt}$	0.00047	47	46	47	48	48	48

n-PROPYL PROPIONATE $C_2H_5.CO_2n\text{-}C_3H_7$

Constants

Boiling point

122°2	Elsässer (1881)	122°6	Brown (1903)
122°3	Pawlewski (1882)	123°0	Lecat
122°6	Gartenmeister (1886)		

Freezing point: –75° Timmermans

Density

t°	d	
0	0.90192	Elsässer (1881–83)
0	0.9022	Gartenmeister (1886)
20	0.8816	„ (1890)

Viscosity

t°	$\eta \cdot 10^5$	
20	686	Gartenmeister (1890)

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He bl.	He v.	Hγ	
14.95	1.39377	1.39406	1.39606	1.39987	1.40080	1.40177	1.40359	1.40472	Eykman (1919)

Heat of combustion	18°5 → 20° (c_v) 7291.4 cal 15°/g	Schjänberg (1934)

Iso-BUTYLPROPIONATE: $C_2H_5.CO_2CH_2CH(CH_3)_2$: *boiling point* and *density:* Elsässer (1881–83); *boiling point, density* and *refractive index:* Munch (1926); *boiling point, density, refractive index* and *heat of combustion:* Schjänberg (1934–35); *boiling point* and *density:* Lecat.

The other butyl and amyl compounds have not been well studied.

		PROPIONATES					
		n-HEXYL- $C_2H_5.CO_2n\text{-}C_6H_{13}$		*n*-HEPTYL- $C_2H_5.CO_2n\text{-}C_7H_{15}$		*n*-OCTYL- $C_2H_5.CO_2n\text{-}C_8H_{17}$	
Constants		GISSELEIRE (1935)		BILTERYS (1935)		GISSELEIRE (1935)	
Boiling point:		190°0		210°04		227°93	
$\frac{dt}{dp}$ *(10 mm):*		—		0°53		0°57	
Freezing point:		−57°5		−50°9		−41°6	
Density:	0°	0.88761		0.88492 0.8845 GARTENMEISTER (1886)		0.88271 0.8832 GARTENMEISTER (1886)	
	15°	0.87423		0.87211		0.87044	
	30°	0.86093		0.85937		0.85812	
Viscosity $\eta \cdot 10^5$:	15°	1377		1718		2128	
	30°	1057		1309		1581	
Surface tension:	15°	27.28		—		28.17	
	20°	26.75		—		27.68	
	30°	25.67		—		26.71	
Refractive index:	15°		$\frac{dn}{dt}$		$\frac{dn}{dt}$		$\frac{dn}{dt}$
	He r.	1.41359	0.00040	1.41745	0.00038	1.42185	0.00037
	Hα	1.41389	40	1.41783	38	1.42209	36
	He y.	1.41621	40	1.42005	39	—	—
	He g.	—	—	1.42418	40	1.42871	37
	Hβ	1.42144	40	1.42523	40	1.42951	36

sec-BUTYL, AMYL, HEXYL, HEPTYL, OCTYL, UNDECYL PROPIONATES: $C_2H_5.CO_2$ *sec.*-C_4H_9, C_5H_{11}, C_6H_{13}, C_7H_{15}, C_8H_{17}, $C_{11}H_{23}$: PICKARD and KENYON (1914) and DUNSTAN, THOLE and BENSON (1914).

METHYL *n*-BUTYRATE $n\text{-}C_3H_7.CO_2CH_3$

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. mm	d cr.	
281.3	26055	0.3002	YOUNG (1910)

Densities of the liquid and saturated vapour

t°	L.	V.	t°	L.	V.	t°	L.	V.	
0	0.92006	0.00004	110	0.7945	0.004374	220	0.6251	0.04831	YOUNG (1910)
10	0.9093	0.0001	120	0.7816	0.005708	230	0.6018	0.05848	„
20	0.8984	0.0001	130	0.7685	0.007353	240	0.5773	0.07143	„
30	0.8773	0.0002	140	0.7551	0.009294	250	0.5505	0.08696	„
40	0.8760	0.0003	150	0.7415	0.01168	260	0.5166	0.1091	„
50	0.8649	0.0005	160	0.7270	0.01459	270	0.4721	0.1416	„
60	0.8535	0.0008	170	0.7122	0.01807	275	0.4386	0.1691	„
70	0.8422	0.0012	180	0.6964	0.02215	278	0.4100	0.1948	„
80	0.8308	0.0017	190	0.6800	0.02699	280	0.3812	0.2201	„
90	0.8188	0.0024	200	0.6633	0.03268	281.3	0.3002	0.3002	„
100	0.8068	0.0033	210	0.6448	0.03968				„

Rectilinear diameter: 0.4601 — 0.0005430 t° — 0.0000000906 $t^{\circ 2}$ YOUNG (1910)

Saturated vapour pressure:

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
0	7.30	80	361.4	160	3328	240	14230	YOUNG (1910)
10	13.80	90	507.0	170	4111	250	16550	„
20	24.55	100	700.7	180	5020	260	19185	„
30	41.95	110	941.0	190	6063	270	22160	„
40	69.20	120	1248	200	7287	275	23795	„
50	109.65	130	1627	210	8684	278	24820	„
60	167.5	140	2100	220	10285	280	25560	„
70	250.3	150	2657	230	12105	281.3	26055	„

Boiling point

102°65		LECAT
102°67		THORPE and RODGER (1897)
102°75	(sample B)	YOUNG and THOMAS (1893) and YOUNG (1910)
102°8	(„ A)	„

Freezing point: —84°8 TIMMERMANS

Constants of state

Density

t°	d		t°	d	
0	0.91994	(sample A)	0	0.92016	(sample C) YOUNG and THOMAS
13.3	0.90577	„	16.0	0.90303	„ „ (1893)
0	0.92010	(sample B)	0	0.92003	(sample D) „
14.1	0.90516	„	16.7	0.90216	„ „

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0.30	755.1	Thorpe and Rodger (1897)	79.46	305.7	Thorpe and Rodger
10.45	652.8		90.63	276.8	„ (1897)
20.38	572.8	„	98.28	259.2	„
30.64	505.0	„	25	546	Kurnakow (1924)
40.58	450.3	„	50	374	„
50.30	405.8	„	70	312	„
60.21	366.8	„	25	541.5	Dunstan, Thole and Benson
71.35	329.5	„	50	407	„ (1914)
			50	374	Kurnakow, Perelmutter and Kanow (1916)

ETHYL *n*-BUTYRATE $n\text{-}C_3H_7.CO_2C_2H_5$

Constants: B.E. (1932)

Boiling point

121°5	Lecat (passim)
121°55	B.E. (1932)
121°7	Pawlewski (1882)

Freezing point: −100°8

Density

t°	d		t°	d	
0	0.89998	B.E. (1932)	25	0.8736	Kurnakow (1924) and Kurnakow, Perelmutter and Kanow (1916)
15	0.88440	„			
30	0.86871	„	50	0.8468	„
			70	0.8279	„
0	0.89957	Elsässer (1881–83)			
25	0.8744	Baker (1913)			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
25	628	KURNAKOW (1924)	15	711	B.E. (1932)
50	466	”	30	595	”
70	380	”	25	635	DUNSTAN, THOLE and BENSON
25	625.3	BAKER (1913)	50	458	” (1914)

Surface tension

t°	γ		t°	γ	
15	25.09	B.E. (1932)	20	24.54	RICHARDS and COOMBS (1915)
20	24.58	”			
30	23.26	”			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.39231	1.39261	—	1.39475	1.39861	1.39946	1.40254	1.40440	B.E. (1932)
$\frac{dn}{dt}$	0.00046	47	—	47	48	48	49	47	”
20	—	1.39038	1.3928	—	—	1.38698	—	1.40069	SCHJÄNBERG (1934–35)

n-PROPYL *n*-BUTYRATE $n\text{-}C_3H_7.CO_2\ n\text{-}C_3H_7$

Boiling point: LECAT (passim), SCHIFF (1884), BROWN (1903), EYKMAN (1919) and PAWLEWSKI (1882); *density:* EYKMAN (1919) and GARTENMEISTER (1890); *viscosity:* GARTENMEISTER (1890); *refractive index:* EYKMAN (1919); *surface tension:* SCHIFF (1884); *boiling point* and *density:* ELSÄSSER (1881–83); *boiling point, density* and *refractive index:* MUNCH (1926); *boiling point, density, refractive index* and *heat of combustion:* SCHJÄNBERG (1934–35).

Iso-PROPYL and *n*-BUTYL *n*-BUTYRATES: $n\text{-}C_3H_7.CO_2CH(CH_3)_2$ and $n\text{-}C_3H_7.CO_2n\text{-}C_4H_9$. *Boiling point, density, refractive index* and *heat of combustion:* SCHJÄNBERG (1934–35).

n-BUTYL *n*-BUTYRATE: *boiling point* and *density:* MUNCH (1926).

Iso-BUTYL *n*-BUTYRATE: $n\text{-}C_3H_7.CO_2CH_2CH(CH_3)_2$. *Critical temperature, boiling point* and *heat of vaporisation:* BROWN (1903–06); *boiling point* and *density:* ELSÄSSER (1881–83); *boiling point:* LECAT; *boiling point* and *density:* MUNCH (1926); *boiling point, density, refractive index* and *heat of combustion:* SCHJÄNBERG (1934–35).

		n-BUTYRATES					
		n-HEXYL- $n\text{-}C_3H_7.CO_2\,n\text{-}C_6H_{13}$		n-HEPTYL- $n\text{-}C_3H_7.CO_2\,n\text{-}C_7H_{15}$		n-OCTYL- $n\text{-}C_3H_7.CO_2\,n\text{-}C_8H_{17}$	
Constants		Bilterys (1935)		Bilterys (1935)		Gisseleire (1935)	
Boiling point:		207°88		225°87		244°1	
$\frac{dt}{dp}$ *(10 mm):*		0°52		0°55		—	
Freezing point:		−78°0		−57°5		−55°6	
Density:	0°	0.8824 Gartenmeister (1886)					
	0°	0.88214		0.88010		0.87875	
	15°	0.86944		0.86782		0.86686	
	30°	0.85670		0.85549		0.85492	
Viscosity $\eta \cdot 10^5$	15°	1678		2064		2491	
	30°	1284		1553		1852	
Surface tension:	15°	—		—		27.55	
	20°	—		—		27.05	
	30°	—		—		26.01	
Refractive index:	15°		$\frac{dn}{dt}$		$\frac{dn}{dt}$		$\frac{dn}{dt}$
	He r.	1.41620	0.00038	1.42010	0.00036	1.42396	0.00034
	Hα	1.41601	39	1.42050	36	1.42443	34
	He y.	1.41875	39	1.42279	37	1.42674	35
	He g.	1.42295	40	1.42709	39	1.43080	34
	Hβ	1.42406	41	1.42802	39	1.43192	35

sec-BUTYL, AMYL, HEXYL, HEPTYL, OCTYL, UNDECYL n-BUTYRATES:
$n\text{-}C_3H_7.CO_2$ *sec.*-C_4H_9, C_5H_{11}, C_6H_{13}, C_7H_{15}, C_8H_{17}, $C_{11}H_{23}$: Pickard and Kenyon (1914)

METHYL *iso*-BUTYRATE $(CH_3)_2CH.CO_2CH_3$

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. mm	d cr.	
267.55	25740	0.3012	Young (1910)

Densities of the liquid and the saturated vapour

t°	L.	V.	t°	L.	V.	t°	L.	V.	
0	0.91131	0.00007	110	0.7815	0.005882	220	0.5961	0.06289	YOUNG (1910)
10	0.9003	0.0001	120	0.7680	0.007628	230	0.5960	0.07722	,,
20	0.8890	0.0002	130	0.7539	0.009718	240	0.5386	0.09615	,,
30	0.8776	0.0004	140	0.7396	0.01224	250	0.5021	0.1218	,,
40	0.8662	0.0006	150	0.7248	0.01533	256	0.4735	0.1437	,,
50	0.8546	0.0009	160	0.7095	0.01903	260	0.4495	0.1623	,,
60	0.8431	0.0013	170	0.6933	0.02345	263	0.4258	0.1838	,,
70	0.8312	0.0018	180	0.6767	0.02869	265	0.4036	0.2033	,,
80	0.8192	0.0025	190	0.6593	0.03490	266.5	0.3790	0.2268	,,
90	0.8069	0.003361	200	0.6411	0.04228	267.55	0.3012	0.3012	,,
100	0.7945	0.004472	210	0.6200	0.05141				,,

Rectilinear diameter: 0.4558 — 0.0005593 t° — 0.0000000689 $t^{\circ 2}$ YOUNG (1910)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
−10	6.22	70	355.2	150	3418	230	14700	YOUNG (1910)
0	12.15	80	505.0	160	4248	240	17190	,,
10	22.40	90	707.0	150	5196	250	19925	,,
20	38.90	100	952.0	180	6291	256	21740	,,
30	65.45	110	1270.0	190	7557	260	23030	,,
40	104.70	120	1662.0	200	9011	263	24080	,,
50	162.0	130	2142.5	210	10690	265	24780	,,
60	243.8	140	2733	220	12570	266.5	25345	,,
23.0	48	51.1	172	76.1	445	102.5	1035	SCHUMANN
26.0	56	57.3	221	80.6	520	105.9	1137	,,
32.3	75	61.9	264	84.4	592	108.7	1242	,, (1881)
37.5	94	65.6	306	87.6	658	111.1	1316	,,
41.6	113	69.3	348	91.0	734	112.7	1370	,,
44.6	130	72.3	387	99.7	946			,,

Boiling point

92°26	THORPE and RODGER (1897)	92°3	ELSÄSSER (1881)
92°3	$\frac{dt}{dp}$ *(10 mm):* 0°42 YOUNG and THOMAS (1893) and YOUNG (1910)	92°4	SCHIFF (1884)
		92°4	BROWN (1903)
		92°5	LECAT

Freezing point: — 87°7 TIMMERMANS

Constants of state

Density

t°	d		t°	d	
0	0.91131	Young (1910)	30	0.8776	Young (1910)
10	0.9003	,,			
20	0.8890	,,	0	0.91118	Elsässer (1881)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
0.29	668.9	35.81	431.7	76.22	303.7	Thorpe and Rodger
9.40	591.5	44.66	393.3	79.77	281.3	,, (1897)
18.12	529.9	52.55	363.1	88.85	258.9	,,
28.98	466.0	62.72	328.9			,,

ETHYL *iso*-BUTYRATE $(CH_3)_2CH.CO_2C_2H_5$

Constants

Boiling point

109°8	Brown (1903)	110°1	Lecat (passim)
109°9	Schiff (1886)	110°1	Elsässer (1881–83)
110°0	Richards and Mathews (1908)	110°2	Schiff (1883–84)

Density *Viscosity*

t°	d		t°	$\eta \cdot 10^5$	
0	0.890367	Elsässer (1881–83)	20	601	Gartenmeister (1890)
20	0.8662	Gartenmeister (1890)	25	557	Thole (1914)

Surface tension

t°	γ	
5.2	24.79	Schiff (1884)
20	23.26	Richards and Mathews (1908)

Refractive index: Marsden and Evans (1937)

Iso-PROPYL *iso*-BUTYRATE $(CH_3)_2CH.CO_2CH(CH_3)_2$

Constants: Young and Fortey (1902)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm
10	6.55	80	201.1	140	1290	200	4742
20	11.95	90	289.4	150	1649	210	5700
30	20.9	100	406.0	160	2096	220	6785
40	35.05	110	553.4	170	2612	230	8058
60	89.0	120	743.9	180	3216		
70	136.0	130	994	190	3916		

Boiling point: 120°76

Density

t°	d	
0	0.86867	(sample A)
0	0.86874	(sample B)
21.35	0.84708	„

n-PROPYL and *n*-AMYL *iso*-BUTYRATES: Elsässer (1881—83).

Iso-BUTYL *iso*-BUTYRATE $(CH_3)_2CH.CO_2CH_2.CH(CH_3)_2$

Constants

Critical temperature: 328°74 Brown (1906)

Saturated vapour pressure: Schumann (1882)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
65.3	43	90.6	122	117.3	315	144.7	730
69.1	50	94.0	140	120.3	347	150.7	843
74.7	60	97.8	161	124.8	398	154.3	928
77.3	70	100.4	178	128.0	441	159.8	1067
81.2	82	105.8	214	136.4	572	165.0	1217
85.8	100	109.4	243	141.6	662	168.1	1310

Boiling point		*Freezing point*	
148°6	Lecat	−80°7	Timmermans
148°65	Timmermans		

Density

t°	d	
0	0.87496	Elsässer (1881–83)

n-VALERATES

		n-HEXYL- n-$C_4H_9.CO_2n$-C_6H_{13}		n-HEPTYL- n-$C_4H_9.CO_2n$-C_7H_{15}		n-OCTYL- n-$C_4H_9.CO_2n$-C_8H_{17}	
Constants		Bilterys (1935)		Bilterys (1935)		Gisseleire (1935)	
Boiling point:		226°30		245°21		261°6	
$\frac{dt}{dp}$ *(10 mm)*		0°55		0°58		—	
Freezing point:		−63°1		−46°4		−42°5	
Density:	0°	0.8796 Gartenmeister (1886)		0.8785 Gartenmeister (1886)		—	
	0°	0.87992		0.87830		0.87712	
	15°	0.86755		0.86625		0.86541	
	30°	0.85524		0.85426		0.85361	
Viscosity $\eta \cdot 10^5$:	15°	1974		2414		2908	
	30°	1490		1787		2099	
Surface tension:	15°	—		—		28.92	
	20°	—		—		28.32	
	30°	—		—		27.07	
Refractive index:	15°		$\frac{dn}{dt}$		$\frac{dn}{dt}$		$\frac{dn}{dt}$
	He r.	1.42028	—	1.42369	0.00037	1.42727	0.00037
	Hα	1.42142	39	1.42395	36	1.42743	36
	He y.	1.42286	38	1.42635	38	—	—
	He g.	1.42711	39	1.43061	37	—	—
	Hβ	1.42809	38	1.43163	38	1.43784	36

METHYL-, ETHYL-, and n-PROPYL-n VALERATES: n-$C_4H_9.CO_2CH_3$, n-$C_4H_9.CO_2C_2H_5$, n-$C_4H_9.CO_2nC_3H_7$: *Boiling point* and *density:* ELSÄSSER (1881–83); *Boiling point, freezing point, density* and *viscosity:* GARTENMEISTER (1886–90). (n-$C_4H_9.CO_2C_2H_5$): *Boiling point:* LECAT.

sec-BUTYL, AMYL, HEXYL, HEPTYL, OCTYL, UNDECYL n-VALERATES: n-$C_4H_9.CO_2$ *sec*-C_4H_9, C_5H_{11}, C_6H_{13}, C_7H_{15}, C_8H_{17}, $C_{11}H_{23}$: PICKARD and KENYON (1914).

ETHYL TRIMETHYLACETATE $(CH_3)_3C.CO_2C_2H_5$

Constants: HOWARD, MEARS, FOOKSON, POMERANTZ and BROOKS (1947)

Boiling point: 118°35 $\frac{dt}{dp}$ *(10 mm):* 0°458

Freezing point: —89°55

Density: 20° 0.85467 25° : 0.84952

Refractive index: $n_D^{20°}$ 1.39061 $n_D^{25°}$ 1.38821 $\frac{dn}{dt}$ 0.00048

METHYL n-CAPROATE n-$C_5H_{11}.CO_2CH_3$

Constants: Bilterys (1935)

Boiling point: 151°25 $\frac{dt}{dp}$ (10 mm): 0°48 *Freezing point:* —71°0

Density

t°	d	
0	0.90327	
15	0.88932	
30	0.87528	

Viscosity

t°	$\eta \cdot 10^5$	
15	936.2	
30	771.2	

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	
15	1.40454	1.40488	1.40699	1.41104	1.41200	
$\frac{dn}{dt}$	0.00039	38	38	40	42	

n-CAPROATES

		n-PROPYL- $n\text{-}C_5H_{11}.CO_2nC_3H_7$		n-BUTYL- $n\text{-}C_5H_{11}.CO_2nC_4H_9$		n-AMYL- $n\text{-}C_5H_{11}.CO_2nC_5H_{11}$	
Constants: Bilterys (1935); Hoback, Parsons and Bartlett (1944) (2)							
Boiling point:		187°15		207°74		226°16	
$\frac{dt}{dp}$ *(10 mm)*		0°51		0°52		0°53	
Freezing point:		−74°0		−63°1		−50°0	
		−68°7 (2)		−64°3 (2)		−47°0 (2)	
Density:	0°	0.88508		0.88216		0.88001	
	15°	0.87142		0.86953		0.86761	
	30°	0.85872		0.85685		0.85526	
	0°	0.88470 (2)		0.8821 (2)		0.8801 (2)	
	25°	0.8632 (2)		0.8623 (2)		0.8612 (2)	
Viscosity $\eta \cdot 10^5$	15°	1364		1626		1980	
	30°	1060		1253		1495	
Refractive index:	15°		$\frac{dn}{dt} \cdot 10^5$		$\frac{dn}{dt} \cdot 10^5$		$\frac{dn}{dt} \cdot 10^5$
	He r.	1.41146	40	1.41613	39	1.42019	38
	Hα	1.41179	40	1.41651	39	1.42054	38
	He y.	1.41401	40	1.41877	40	1.42280	39
	He g.	1.41816	41	1.42295	41	1.42699	39
	Hβ	1.41914	41	1.42400	42	1.42809	40

ETHYL-n-CAPROATE $n\text{-}C_5H_{11}.CO_2C_2H_5$

Constants: Simon (1929)

Boiling point

167°7	Lecat
167°85	Simon (1929)

Freezing point

−67°5	Simon (1929)
−67°6	Van Bellinghen (1938)

Density

t°	d	
0	0.88956	Simon
15	0.87583	(1929)
30	0.86196	„

Viscosity

t°	$\eta \cdot 10^5$	
15	1098	Simon (1929)
30	871	„
25	929	Dunstan, Thole and Benson (1914)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.40738	1.40763	1.40971	1.40985	1.41382	1.41480	1.41796	1.41907
25	1.40317	1.40342	1.40544	1.40559	1.40957	1.41055	1.41363	1.41475
$\frac{dn}{dt}$	0.00042	42	43	44	43	43	43	43

n-CAPROATES

		n-HEXYL- n-$C_5H_{11}.CO_2n$-C_6H_{13}		n-HEPTYL- n-$C_5H_{11}.COn$-$_2C_7H_{15}$		n-OCTYL- n-$C_5H_{11}.CO_2n$-C_8H_{17}	
Constants		Bilterys (1935)		Bilterys (1935)		Gisseleire (1935)	
Boiling point:		245°43		260°97		275°2	
Freezing point:		−55°25		−34°4		−28°4	
Density:	0°	0.87823		0.87690		0.87582	
	15°	0.86617		0.86508		0.86418	
	30°	0.85414		0.85330		0.85259	
	0°	—		0.8768 Gartenmeister (1886)		—	
Viscosity $\eta \cdot 10^5$	15°	2391		2896		3451	
	30°	1767		2101		2494	
Surface tension:	15°	—		—		28.59	
	20°	—		—		28.14	
	30°	—		—		27.24	
Refractive index: 15°			$\frac{dn}{dt}$		$\frac{dn}{dt}$		$\frac{dn}{dt}$
	He r.	1.42391	0.00040	1.42669	0.00036	1.42999	0.00034
	Hα	1.42418	39	1.42706	36	1.43011	34
	He y.	1.42637	39	1.42934	37	1.42256	34
	He g.	1.43054	40	1.43358	37	1.43687	34
	Hβ	1.43165	40	1.43459	37	1.43788	34

n-NONYL, UNDECYL, DODECYL, TRIDECYL, TETRADECYL, PENTADECYL n-CAPROATES: n-$C_5H_{11}.CO_2n$-C_9H_{19}, $C_{11}H_{23}$, $C_{12}H_{25}$, $C_{13}H_{27}$, $C_{14}H_{29}$, $C_{15}H_{31}$: Hoback, Parsons and Bartlett (1944).

sec-BUTYL, HEXYL, HEPTYL, OCTYL, NONYL n-CAPROATES: n-$C_5H_{11}.CO_2$-*sec*C_4H_9 C_6H_{13}, C_7H_{15}, C_8H_{17}, C_9H_{19}: Pickard and Kenyon (1914).

ETHYL OENANTHATE $n\text{-}C_6H_{13}.CO_2C_2H_5$

Constants

Boiling point

188°55	$\frac{dt}{dp}$ *(10 mm)* : 0°54	GISSELEIRE (1935)
188°6		DEFFET (1931)

Freezing point

−66°1	DEFFET (1931)	−66°3	GISSELEIRE (1935)

Density

t°	d		t°	d	
0	0.88619	DEFFET (1931)	0	0.88622	GISSELEIRE (1935)
15	0.87297	,,	15	0.87297	,,
30	0.85968	,,	30	0.85973	,,
0	0.8860	GARTENMEISTER (1886)			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	1388	DEFFET (1931)	15	1355	GISSELEIRE (1935)
30	1071	,,	30	1050	,,

Surface tension

t°	γ		t°	γ	
15	27.02	HENNAUT-ROLAND and LEK	15	26.91	GISSELEIRE (1935)
20	26.43	,, (1931)	20	26.43	,,
30	25.45	,,	30	25.46	,,

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ	
15	1.41286	1.41321	1.41540	1.41947	1.42050	1.42351	1.42486	Deffet (1931)
$\frac{dn}{dt}$	0.00043	42	43	43	44	45	44	„
15	1.41289	1.41312	1.41537	1.41956	1.42059	—	—	Gisseleire (1935)
$\frac{dn}{dt}$	0.00040	40	40	39	40	—	—	„

OENANTHATES

	METHYL- n-$C_6H_{13}.CO_2CH_3$		n-PROPYL- $nC_6H_{13}.CO_2n$-C_3H_7		n-BUTYL- n-$C_6H_{13}.CO_2n$-C_4H_9		n-AMYL- n-$C_6H_{13}.CO_2n$-C_5H_{11}	
Constants:	Bilterys (1935); Hoback, Parsons and Bartlett (1944) (2)							
B.P.	173°80		207°94		226°18		245°44	
$\frac{dt}{dp}$ (*10 mm*)	0°50		0°53		0°55		—	
F.P.	−55°80		−64°8 −63°5 (2)		−68°4 −67°5 (2)		−49°5 −49°0 (2)	
D: 0°	0.89802		0.88266		0.88034		0.87850	
15°	0.88459		0.86982		0.86796		0.86634	
30°	0.87115		0.85705		0.85553		0.85427	
0°	—		0.8823 (2)		0.8799 (2)		0.8780 (2)	
25°	—		0.8610 (2)		0.8592 (2)		0.8580 (2)	
$\eta \cdot 10^5$: 15°	1210		1680		1982		2393	
30°	947		1285		1495		1769	
n: 15°		$\frac{dn}{dt} \cdot 10^5$		$\frac{dn}{dt} \cdot 10^5$		$\frac{dn}{dt} \cdot 10^5$		$\frac{dn}{dt} \cdot 10^5$
He r.	1.41094	40	1.41641	39	1.42020	40	1.42361	38
Hα	1.41125	40	1.41672	39	1.42056	40	1.42397	38
He y.	1.41334	41	1.41894	39	1.42280	40	1.42687	38
He g.	1.41752	39	1.42310	40	1.42698	40	1.43043	38
Hβ	1.41844	39	1.42408	40	1.42801	40	1.43155	38

OENANTHATES

		n-HEXYL- n-$C_6H_{13}.CO_2n$-C_6H_{13}		n-HEPTYL- n-$C_6H_{13}.CO_2n$-C_7H_{15}		n-OCTYL- n-$C_6H_{13}.CO_2n$-C_8H_{17}	
Constants		Bilterys (1935)		Bilterys (1935)		Gisseleire (1935)	
Boiling point:		260°89		277°21		290°75	
$\frac{dt}{dp}$ *(10 mm):*		0°60		0°62		—	
Freezing point:		−47°9		−33°3		−21°5	
Density:	0°	—		0.8760 Gartenmeister (1886)		—	
	0°	0.87681		0.87566		0.87472	
	15°	0.86507		0.86420		0.86341	
	30°	0.85327		0.85277		0.85200	
Viscosity $\eta \cdot 10^5$	15°	2870		3437		3998	
	30°	2082		2434		2846	
Surface tension:	15°	—		—		28.65	
	20°	—		—		28.12	
	30°	—		—		27.05	
Refractive index:	15°		$\frac{dn}{dt}$		$\frac{dn}{dt}$		$\frac{dn}{dt}$
He r.		1.42675	0.00039	1.42918	0.00035	1.43215	0.00032
Hα		1.42711	38	1.42948	35	1.43252	32
He y.		1.42939	38	1.43183	35	1.43488	32
He g.		1.43361	39	1.43604	36	1.43925	33
Hβ		1.43472	40	1.43715	36	1.44026	32

sec-BUTYL, HEXYL, HEPTYL, OCTYL, UNDECYL OENANTHATES: n-$C_6H_{13}.CO_2$ *sec.*-C_4H_9, C_6H_{13}, C_7H_{15}, C_8H_{17}, $C_{11}H_{23}$: Pickard and Kenyon (1914).

ETHYL *n*-CAPRYLATE n-$C_7H_{15}.CO_2C_2H_5$

Constants: Deffet (1931)

Boiling point		*Freezing point*	
208°35	Lecat	α —43°1	Deffet (1931)
208°5	Deffet (1931)	α −43°2	Van Bellinghen (1938)
		β −59°2	,,

Density *Viscosity* *Surface tension*

t°	d	t°	$\eta \cdot 10^5$	t°	γ	
0	0.88351	15	1722	15	27.39	Hennaut-Roland and Lek (1931)
15	0.87075	30	1321	20	26.91	,,
30	0.85802			30	25.97	,,

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.41738	1.41775	1.41989	1.42434	1.42524	1.42813	1.4294
$\frac{dn}{dt}$	0.00040	40	40	40	40	41	—

n-CAPRYLATES

Constants: Hoback, Parsons and Bartlett (1944) (2)

		n-PROPYL- $n\text{-}C_7H_{15}.CO_2n\text{-}C_3H_7$		n-BUTYL- $n\text{-}C_7H_{15}.CO_2n\text{-}C_4H_9$		n-AMYL- $n\text{-}C_7H_{15}.CO_2n\text{-}C_5H_{11}$	
		Bilterys (1935)		Bilterys (1935)		Gisseleire (1935)	
Boiling point:		226°43		245°02		260°21	
$\frac{dt}{dp}$ *(10 mm):*		—		0°58		—	
Freezing point:		−46°2		−41°9		−34°8	
		−45°0 (2)		−43°0 (2)		−34°5 (2)	
Density:	0°	0.88230		0.87880		0.87714	
	15°	0.87000		0.86671		0.86525	
	30°	0.85773		0.85479		0.85345	
	0°	0.8820 (2)		0.8786 (2)		0.8770 (2)	
	25°	0.8616 (2)		0.8584 (2)		0.8562 (2)	
Viscosity $\eta \cdot 10^5$:	15°	2198		2442		2916	
	30°	1654		1805		2097	
Surface tension:	15°	—		—		28.18	
	20°	—		—		27.80	
	30°	—		—		26.92	
Refractive index:	15°		$\frac{dn}{dt}$		$\frac{dn}{dt}$		$\frac{dn}{dt}$
	He r.	1.42084	0.00036	1.42381	0.00037	1.42755	0.00039
	Hα	1.42120	36	1.42418	37	1.42781	36
	He y.	1.42351	37	1.42647	37	1.43019	36
	He g.	1.42770	38	1.43083	38	1.43441	36
	Hβ	1.42863	37	1.43176	38	1.43521	36

n-CAPRYLATES

		n-HEXYL- $n\text{-}C_7H_{15}.CO_2n\text{-}C_6H_{13}$		n-HEPTYL- $n\text{-}C_7H_{15}.CO_2n\text{-}C_7H_{15}$		n-OCTYL- $n\text{-}C_7H_{15}.CO_2n\text{-}C_8H_{17}$	
Constants		Bilterys (1935)		Gisseleire (1935)		Gisseleire (1935)	
Boiling point:		277°44		290°6		306°8	
$\frac{dt}{dp}$ *(10 mm):*		0°62		—		—	
Freezing point:		−30°6		−10°2		−15°1	
Density:	0°	0.87564		0.87472		0.87403	
	15°	0.86414		0.86335		0.86292	
	30°	0.85270		0.85204		0.85172	
Viscosity $\eta \cdot 10^5$	15°	3445		3981		4825	
	30°	2453		2828		3684	
Surface tension:	15°	—		28.76		28.85	
	20°	—		28.24		28.29	
	30°	—		27.28		27.15	
Refractive index:	15°		$\frac{dn}{dt}$		$\frac{dn}{dt}$		$\frac{dn}{dt}$
	He r.	1.42965	0.00037	1.43220	0.00032	1.43417	0.00033
	Hα	1.43001	37	1.43256	33	1.43451	33
	He y.	1.43230	37	1.43492	33	1.43698	33
	He g.	1.43668	37	1.43929	33	1.44125	34
	Hβ	1.43769	37	1.44024	33	1.44225	33

For METHYL n-CAPRYLATE and PELARGONATE, there are no reliable data.

sec-BUTYL, HEPTYL, OCTYL n-CAPRYLATES: $n\text{-}C_7H_{15}.CO_2$ $sec\text{-}C_4H_9$, C_7H_{15}, C_8H_{17} Pickard and Kenyon (1914).

n-PROPYL, n-BUTYL, n-AMYL n-PELARGONATES:
$n\text{-}C_8H_{17}.CO_2n\text{-}C_3H_7$, $n\text{-}C_4H_9$, $n\text{-}C_5H_{11}$: Hoback, Parsons and Bartlett (1944).

		ETHYL n-PELARGONATE n-$C_8H_{17}.CO_2C_2H_5$		ETHYL n-CAPRATE n-$C_9H_{19}.CO_2C_2H_5$	
Constants: Deffet (1931)					
Boiling point:		227°0 227° Brown (1903)		244°9	
Freezing point:		β −36°7 α −55°0 Van Bellinghen β −36°8 „ (1938) γ −43°6 „		β −19°9 β −19°95 Van Bellinghen (1938) γ −30°6 „ α −18°0 Hoerr, Harwood and Ralston (1944) β −19°5 „	
Density:	0°	0.888156		0.88027	
	15°	0.86920		0.86811	
	30°	0.85693		0.85599	
Viscosity $\eta \cdot 10^5$	15°	2106		2624	
	30°	1572		1873	
Surface tension:	15°	28.02 Hennaut-Roland and Lek (1931)		—	
	20°	27.57 „		—	
	30°	26.72 „		—	
Refractive index:	15°		$\frac{dn}{dt}$		$\frac{dn}{dt}$
	He r.	1.42147	0.00041	1.42506	0.00038
	Hα	1.42183	41	1.42542	38
	He y.	1.42415	42	1.42771	38
	He g.	1.42839	41	1.43202	39
	Hβ	1.42944	41	1.43307	—
	He v.	1.43247	42	1.43604	39
	Hγ	1.43367	—	1.43723	39

ETHYL LAURATE: $C_{11}H_{23}.CO_2C_2H_5$: Eykman (1919).

ETHYL n-UNDECOATE, n-DODECOATE (LAURATE) and n-TRIDECOATE: n-$C_{10}H_{21}.CO_2C_2H_5$ n-$C_{11}H_{23}.CO_2C_2H_5$, n-$C_{12}H_{25}.CO_2C_2H_5$: *Melting point* and *polymorphism;* Van Bellinghen (1938).

sec-BUTYL, AMYL, HEXYL, HEPTYL, OCTYL, NONYL, DECYL, UNDECYL, DODECYL, TRIDECYL, n-PELARGONATES, n-UNDECOATES, n-DODECOATES (LAURATES): n-$C_8H_{17}.CO_2R$, n-$C_{10}H_{21}.CO_2R$, n-$C_{11}H_{23}.CO_2R$ (R = alkyl): Pickard and Kenyon (1914).

METHYL and ETHYL MYRISTATES: $C_{13}H_{27}.CO_2CH_3$ and C_2H_5: Garner and Rushbrooke, (1927); Hoerr, Harwood and Ralston (1944).

sec-BUTYL, HEXYL, HEPTYL, OCTYL, UNDECYL MYRISTATES: $C_{13}H_{27}.CO_2$ *sec.* C_4H_9, C_6H_{13}, C_7H_{15}, C_8H_{17}, $C_{11}H_{23}$*;* Pickard and Kenyon (1914).

ETHYL STEARATE $n\text{-}C_{17}H_{35}.CO_2C_2H_5$

Melting point:

St. form.	Unst. form.	
33°4	30°9	Van Bellinghen (1938)
33°8	31°05	Hoerr, Harwood and Ralston (1944)

Melting curve:

St. form.			Unst. form.		
t°	p kg/cm²		t°	p kg/cm²	
33.4	1	Deffet (1940)	30.9	1	Deffet (1940)
37.50	192	,,	35.00	184	,,
40.00	318	,,	37.50	307	,,
50.00	780	,,	40.00	428	,,
53.00	925	,,	45.00	683	,,
			50.00	927	,,

The METHYL and ETHYL PALMITATES have not been studied carefully.

n-PROPYL PALMITATE and STEARATE: $C_{15}H_{31}.CO_2n\text{-}C_3H_7$ and $C_{17}H_{35}.CO_2\ n\text{-}C_3H_7$: Eykman (1919).

sec-BUTYL, HEXYL, HEPTYL, OCTYL, UNDECYL PALMITATES: $n\text{-}C_{15}H_{31}.CO_2$ *sec.* C_4H_9, C_6H_{13}, C_7H_{15}, C_8H_{17}, $C_{11}H_{23}$: Pickard and Kenyon (1914).

sec-BUTYL, HEXYL, HEPTYL, OCTYL STEARATES: $n\text{-}C_{17}H_{35}.CO_2$ *sec.* C_4H_9, C_6H_{13}, C_7H_{15}, C_8H_{17}: Pickard and Kenyon (1914).

ETHYLENE GLYCOL DIACETATE or ETHYLENE DIACETIN $(CH_3CO_2.CH_2)_2$

Saturated vapour pressure, density and *refractive index:* Taylor and Rinkenbach (1926) *Boiling point:* Lecat.

GLYCERIDES

TRIBUTYRIN, TRICAPROIN and TRICAPRYLIN: $(CH_2CO_2R)_2.CHCO_2R$; ($R{=}n\text{-}C_3H_7$; $R{=}n\text{-}C_5H_{11}$; $R{=}n\text{-}C_7H_{15}$). Scheij (1899)

TRICAPRIN $(CH_2CO_2n\text{-}C_9H_{19})_2.CHCO_2n\text{-}C_9H_{19}$

Constants

Freezing point

31°0	Loskit (1928)
31°1	Scheij (1899)

Density

t°	d		t°	d	
40	0.9204	Joglekar and Watson	40	0.9205	Scheij (1899)
60	0.9059	„ (1928)	60	0.9057	„
70	0.8986	„			
80	0.8913	„			

Viscosity

t°	$\eta \cdot 10^4$		t°	$\eta \cdot 10^4$	
45	1006	Joglekar and Watson	75	625	Joglekar and Watson
60	777	„ (1928)	85	551	„ (1928)
70	688	„			

Surface tension

t°	γ		t°	γ	
40	28.7	Joglekar and Watson	70	26.6	Joglekar and Watson
60	27.3	„ (1928)	80	25.9	„ (1928)

Refractive index

t°	n_D	t°	n_D	
40	1.44461	60	1.43697	Scheij (1899)

TRILAURIN $C_3H_5(CO_2.n\text{-}C_{11}H_{23})_3$

Constants

Melting point: 46°4 Scheij (1899)

Density

t°	d		t°	d	
60	0.8943	Joglekar and Watson	60	0.8944	Scheij (1899)
70	0.8872	„ (1928)			
80	0.8801	„			

Viscosity

t°	$\eta \cdot 10^4$		t°	$\eta \cdot 10^4$	
45	2198	Joglekar and Watson	75	911	Joglekar and Watson
60	1359	„ (1928)	80	809	„ (1928)
70	1030	„	85	722	„

Surface tension / *Refractive index*

t°	γ		t°	n_D	
60	27.9	Joglekar and Watson	60	1.44039	Scheij (1899)
70	27.3	„ (1928)			
80	26.6	„			

α- and β-MONOPALMITIN: $C_3H_5(OH)_2CO_2n\text{-}C_{15}H_{31}$: Clarke and Stegeman (1940)

TRIPALMITIN $C_3H_5(CO_2n\text{-}C_{15}H_{31})_3$

Constants

Freezing point

64°8	Loskit (1928)
65°1	Scheij (1899)
65°5	Guth (1903)

Density

t°	d		t°	d	
70	0.8730	Joglekar and Watson	80	0.8657	Scheij (1899)
80	0.8663	„ (1928)			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
70	1679	Joglekar and Watson	80	1292	Joglekar and Watson
75	1467	„ (1928)	85	1144	„ (1928)

Surface tension / *Refractive index*

t°	γ		t°	n_D	
70	28.3	Joglekar and Watson	80	1.43807	Scheij (1899)
80	27.6	„ (1928)			

ETHYL CARBONATE $CO_3(C_2H_5)_2$

Constants: B.E. (1930)

Boiling point *Freezing point*

126°5	$\frac{dt}{dp}$ *(10 mm):* 0°42 Lecat	−43°0	B.E. (1930)
126°8	„ 0°42 B.E. (1930)		

Density

t°	d		t°	d	
0	0.99707	B.E. (1930)	25	0.96926	Bowden and Butler (1939)
15	0.98043	„			
30	0.96393	„			

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	868	B.E. (1930)	15	26.94	B.E. (1930)
30	698	„	20	26.44	„
25	747.6	Bowden and Butler (1939)	30	25.47	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.38422	1.38452	—	1.38654	1.39011	1.39085	1.39379	1.39489	B.E. (1930)
$\frac{dn}{dt}$	0.00040	40	—	39	40	40	42	42	„
25	—	—	1.38287	—	—	—	—	—	Bowden and Butler (1939)

Dielectric constant: 20° 2.819 Piette (1947).

ETHYL OXALATE $(CO_2C_2H_5)_2$

Constants: B.E. (1930)

Boiling point

185°19	$\frac{dt}{dp}$ *(10 mm):* 0°51	Louguinine (1880)
185°4	„ 0°52	B.E. (1930)
185°65	„ 0°57	Lecat (passim)

Freezing point: −40°6

Density

t°	d		t°	d	
12	1.0879	Schwers (1911)	0	1.10169	B.E. (1930
13.45	1.08631	„	15	1.08426	„
33.6	1.06270	„	30	1.06687	„
53.45	1.03963	„	15.75	1.0834	Auwers (1918)
75.75	1.01269	„	25	1.0725	Dunstan, Hilditch and Thole (1913)
95.65	1.08829	„	20	1.0785	Meares (1949)

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	2311	B.E. (1930)	15	32.83	B.E. (1930)
30	1618	„	20	32.22	„
			30	31.03	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.40974	1.41011	—	1.41239	1.41656	1.41761	1.42086	1.42225	B.E. (1930)
$\frac{dn}{dt}$	0.00042	41	—	42	42	41	42	41	„
12	—	—	1.4137	—	—	—	—	—	Schwers (1911)

sec-OCTYL OXALATE: $(CO_2sec\text{-}C_8H_{17})_2$: *Specific rotatory power for various wave-lengths;* Lowry and Richards (1924).

ETHYL MALONATE $(CO_2C_2H_5)_2.CH_2$

Constants: B.E. (1934)

Boiling point

199°30	$\frac{dt}{dp}$ *(10 mm)*: 0°58 B.E. (1934)
199°35	„ 0°58 Lecat

Freezing point −51°5

Density

t°	d		t°	d	
0	1.07623	B.E. (1934)	16.8	1.0581	Eykman (1893–1919)
15	1.06040	„	20	1.0550	Karvonen (1917)
30	1.04460	„	25	1.0501	Dunstan, Hilditch and Thole (1913)
16.6	1.0587	Brühl (1894)			
20	1.0553	„	30	1.0445	Beck, Macbeth and Pennycuick (1932)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	2377	B.E. (1934)	25	1875	Dunstan, Hilditch and Thole (1913)
30	1753	„			

Surface tension

t°	γ		t°	γ	
15	32.31	B.E. (1934)	30	30.56	Beck, Macbeth and Pennycuck (1932)
20	31.71	„			
30	30.49	„			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.41354	1.41393	—	1.41626	1.42034	1.42140	1.42450	—	B.E. (1934)
$\frac{dn}{dt}$	0.00038	37	—	39	38	38	40	—	„
16.8	—	1.41342	—	—	—	1.42048	—	—	Eykman (1893–1919)
80	—	1.38579	—	—	—	1.39234	—	—	„
20	—	1.41413	1.41618	—	—	1.42120	—	1.42356	Karvonen (1917)

METHYL SUCCINATE $(CH_2.CO_2CH_3)_2$

Constants

Boiling point | *Freezing point*

195°5	Lecat (passim)	18°2	Viseur (1926)
195°9	Viseur (1926)	18°2	Kendall and Booge (1916)
		18°5	Perkin (1884–85)
		19°	Bruni and Gorni (1900)
		19°5	Bruni and Amadori (1910)

Density

t°	d		t°	d	
15	1.12525	Viseur (1926)	15	1.12513	Perkin (1884–85)
18	1.12189	„	25	1.11393	„
20	1.11961	„			
25	1.11398	„			

Magnetic rotatory power: 18°2 0.8630 Perkin (1884–85)

ETHYL SUCCINATE $(CH_2.CO_2C_2H_5)_2$

Constants

Boiling point | *Freezing point*

217°25	Lecat	−20°8	Schneider (1897)
217°75	Viseur (1926)	−20°8	Kendall and Booge (1916)
		−21°3	Timmermans

Density

t°	d		t°	d	
15	1.04554	Perkin (1884)	19	1.0416	Patterson, Henderson and Fairlie (1907)
25	1.03529	„			
15	1.04562	Viseur (1926)	24.8	1.03543	„
25	1.0349	Smyth and Walls (1931)	28.04	1.03228	„
			31.75	1.02841	„

Refractive index: $n_D^{20°}$: 1.42010 SMYTH and WALLS (1931)

Magnetic rotatory power: 17°8 0.9053 PERKIN (1884)

n-PROPYL SUCCINATE $(CH_2CO_2n\text{-}C_3H_7)_2$

Boiling point, density and *magnetic rotatory power;* PERKIN (1888); *melting point:* −11°0: TIMMERMANS.

ETHYL GLUTARATE $(CH_2)_3(CO_2C_2H_5)_2$

Constants: SERWY (1933)

Boiling point		*Freezing point*	
233°68		−23°80	TIMMERMANS

Density

t°	d		t°	d	
0	1.04202	SERWY (1933)	14.9	1.0272	EYKMAN (1919)
15	1.02704	,,	25	1.0170	SMYTH and WALLS (1931)
30	1.01210	,,			

Viscosity

t°	$\eta \cdot 10^5$	
15	3260	SERWY (1933)
30	2311	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.42294	1.42333	—	1.42570	1.42982	1.43086	1.43382	1.43820	SERWY (1933)
$\frac{dn}{dt}$	0.00039	39	—	39	40	41	41	—	,,
20	—	—	1.42400	—	—	—	—	—	SMYTH and WALLS (1931)

ETHYL ADIPATE $(CH_2)_4(CO_2C_2H_5)_2$

Constants		CHIURDOGLU (1935)	SERWY (1933)	
Boiling point:		133°8/15 mm	131°/13 mm	
Freezing point:		−19°8	−19°9	
Density:	0°	1.02590	1.02589	
	15°	1.01165	1.01165	
	20°	1.00693	—	
	30°	0.99440	0.99744	
Viscosity $\eta \cdot 10^5$:	15°	3881	3871	
	30°	2705	2648	
Refractive index:		20°	15°	$\frac{dn}{dt}$
	He r.	—	1.42673	0.00039
	Hα	1.42557	1.42708	38
	He y.	1.42770	1.42924	37
	He g.	—	1.43362	38
	Hβ	1.43279	1.43463	38
	He v.	—	1.43783	40
	Hγ	1.43697	1.44335	38

n-AMYL OXALATE: $(CO_2n\text{-}C_5H_{11})_2$; *n*-PROPYL and *n*-AMYL MALONATES: $CH_2(CO_2n\text{-}C_3H_7)_2$ and $CH_2(CO_2n\text{-}C_5H_{11})_2$; *n*-PROPYL, *n*-BUTYL and *n*-AMYLGLUTARATES: $(CH_2)_3(CO_2n\text{-}C_3H_7)_2$, $(CH_2)_3(CO_2n\text{-}C_4H_9)_2$, $(CH_2)_3(CO_2n\text{-}C_5H_{11})_2$; *n*-PROPYL and *n*-BUTYL PIMELATES: $(CH_2)_5(CO_2n\text{-}C_3H_7)_2$ and $(CH_2)_5(CO_2n\text{-}C_4H_9)_2$: SERWY (1933).

METHYL and ETHYL PIMELATES $(CH_3CO_2)_2(CH_2)_5$
„ „ SUBERATES $(C_2H_5CO_2)_2(CH_2)_6$
„ „ AZELATES $(C_2H_5CO_2)_2(CH_2)_7$
Melting point, density, surface tension and *refractive index;* VOGEL (1934).

METHYL-ALKYLMALONATES: VOGEL (1934).
$(CH_3CO_2)_2.CHR$ $(R=CH_3;\ C_2H_5;\ n\text{-}C_3H_7)$
$(CH_3CO_2)_2.CR_2$ $[R_2=(CH_3)_2;\ CH_3C_2H_5;\ CH_3n\text{-}C_3H_7;\ C_2H_5\ n\text{-}C_3H_7;\ (n\text{-}C_3H_7)_2]$

ETHYL DIMETHYLSUCCINATE: $(C_2H_5CO_2.CHCH_3)_2$: *Refractive index* and *heat of combustion:* BERNER (1926).

iso-BUTYL *l.* LACTATE
dl. sec. „ *l.* „
d. „ „ *d.* „
d. „ „ *l.* „
tert. „ *l.* „
iso- „ *l.* „

$CH_3.CHOH.CO_2C_4H_9$ *Density* and *rotatory power:* WOOD, SUCH and SCARF (1926)

Boiling point: 182°15 LECAT.

METHYL and ETHYL MALATES: $RCO_2.CHOH.CH_2.CO_2R$: ($R=CH_3$; $R=C_2H_5$) *Boiling point, density, refractive index* and *natural* and *magnetic rotatory power;* HERNQUIST (1914).

METHYL TARTRATES: MITCHELL and SMITH (1913) $(CH_3CO_2.CHOH)_2$: The densities of the racemate and the *l.* tartrate are not in agreement; they are also different from the values of WOOD and NICHOLAS (1928) and PATTERSON (1904).

Rotatory dispersion; LOWRY and DICKSON (1915).

Heat of combustion; BERNER (1926) and VERKADE and COOPS (1928).

METHYL *Meso*-TARTRATES $(CH_3CO_2.CHOH)_2$

Melting point and *heat of combustion;* BERNER (1926).

Melting point; MARCKWALD and KARSZAG (1909).

ETHYL TARTRATE $(C_2H_5CO_2.CHOH)_2$

Density; PATTERSON (1901–1908–1916); *melting point, density* and *rotatory power;* WOOD and NICHOLAS (1928); *density, natural* and *magnetic rotatory power;* PERKIN (1887).

The densities of the racemate and the *d.* tartrate (Perkin) agree, but are different from all other values, which moreover, are incompatible with one another.

Rotatory dispersion; LOWRY and DICKSON (1915).

Melting point, density, refractive index, heat of combustion; BERNER (1926).

ETHYL *Meso*-TARTRATE $(C_2H_5CO_2.CHOH_2)$

Melting point and *heat of combustion;* BERNER (1926).

Boiling and *melting points, density* and *refractive index*: KUHN and WAGNER-JAUREGG (1928).

sec-OCTYL METHOXYACETATE $CH_3OCH_2CO_2sec\text{-}C_8H_{17}$

Density and *rotatory power;* RULE and MITCHELL (1926).

METHYL, ETHYL, *n*-PROPYL, *n*-BUTYL, *iso*-BUTYL, *iso*-AMYL, *sec*-PROPYL, *sec*-BUTYL CROTONATES: $CH_3.CH=CHCO_2R$ ($R=CH_3$, C_2H_5, C_3H_7, C_4H_9, $(CH_3)_2CH.CH_2$, $(CH_3)_2CH.(CH_2)_2$, $(CH_3)_2CH$, $C_2H_5.CH(CH_3)$): *Boiling point, density, refractive index* and *heat of combustion;* SCHJÄNBERG (1936)

METHYL FUMARATE $CH_3CO_2.CH{=}CH.CO_2CH_3$(*trans*)

Constants

Saturated vapour pressure: De Wolf and Van de Straete (1935)

t°	p mm	t°	p mm	t°	p mm
88.5	12	129	73	150	156
112	34	137	94	153	175
117	42				

Boiling point

193°25	Lecat (passim)
193°25	Viseur (1926)

Melting point

101°7	Viseur (1926)
102°	Bruni and Gorni (1900)
102°	Sugden and Whittaker (1925)
102°	Wasserman (1930)

Density

t°	d	
105.5	1.0452	De Wolf and Van de Straete (1935)
110.5	1.0397	„
115.95	1.0332	„
110.7	1.0390	Bruylants (1935)

Surface tension

t°	γ		t°	γ	
106	25.67	Sugden and Whittaker	146	21.20	Sugden and Whittaker
123	23.77	„ (1925)	163	19.18	„ (1925)
132	22.75	„			

Refractive index

t°	Hα	D	Hβ	
110.7	1.40367	1.40625	1.41416	De Wolf and Van de Straete (1915)
110.7	1.40367	—	—	Bruylants (1935)

METHYL MALEATE $CH_3CO_2.CH{=}CH.CO_2CH_3$(*cis*)

Constants

Density

t°	d		t°	d	
105.5	1.0567	Bruylants (1935)	15	1.15557	De Wolf and Van de Straete (1935)
109.0	1.0535	,,			
110.7	1.0524	,,	30	1.13952	,,
114.9	1.0489	,,			

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.44107	1.44407	1.45143	1.45774	De Wolf and Van de Straete (1935)
30	1.43506	1.43814	1.44534	1.45136	,,
110.7	1.40115	—	—	—	Bruylants (1935)

ETHYL FUMARATE $C_2H_5CO_2.CH{=}CH.CO_2C_2H_5$(*trans*)

Constants

Boiling point		*Freezing point*	
217°85	Lecat	0°55	Timmermans

Density

t°	d		t°	d	
12.1	1.06054	Knops (1888)	20.6	1.05189	Patterson, Henderson and Fairlie (1907)
16.9	1.05524	,,			
22.0	1.04986	,,	30.23	1.04210	,,
26.5	1.04516	,,	33.25	1.03897	,,
31.8	1.03958	,,	25	1.0472	Walden and Swinne (1912)

Refractive index

t°	K	t°	Hα	t°	D	t°	Hβ	t°	Hγ	
20.3	1.434206	20.4	1.437625	20.1	1.441026	20.1	1.448964	20.0	1.455968	Knops (1888)
24.8	1.432252	25.3	1.435432	24.4	1.439085	25.0	1.446789	24.5	1.453779	,,
$\frac{dn}{dt}$	0.000434		449		451		444		486	,,

(For other wave-lenghts, see author)

METHYL CITRACONATE(*cis*) METHYL MESACONATE(*trans*)

$CH_3CO_2.CCH_3{=}CH.CO_2CH_3$

Constants: VAN DE STRAETE (1935)

Boiling point:	210°62 (calc.)				202°83 (calc.)		
Density: 15°	1.12110				1.12541		
20°	1.11531				—		
30°	1.10561				1.10914		
Refractive index:	15°	20°	30°	$\frac{dn}{dt}$	15°	30°	$\frac{dn}{dt}$
Hα	1.44752	1.44545	1.44191	0.00037	1.45378	1.44786	0.00039
D	1.45062	1.44856	1.44497	38	1.45707	1.45119	39
Hβ	1.45846	1.45634	1.45270	38	1.46616	1.45998	41
Hγ	1.46514	1.46312	1.45928	39	1.47384	1.46757	42

OLEATES and ELAIDATES

$CH_3 . (CH_2)_7 . CH{=}CH . (CH_2)_7 . CO_2R$

Constants: KEFFLER and MAC LEAN (1935); KEFFLER (1937)

		METHYL $R{=}CH_3$	ETHYL $R{=}C_2H_5$	*n*-PROPYL $R{=}n\text{-}C_3H_7$	*n*-BUTYL $R{=}n\text{-}C_4H_9$
		Oleate	*Oleate*	*Oleate*	*Oleate*
Density:	15°	0.8774	0.8724	—	—
	20°	0.8738	0.8687	—	—
	25°	0.8702	0.8651	—	—
	30°	0.8666	0.8613	0.8601	0.8599
	60°	—	—	0.8389	0.8390
	90°	—	—	0.8175	0.8178
Viscosity:	30°	448	518	586	649
$\eta \cdot 10_4$	60°	262	276	306	334
	90°	164	171	181	207
Heat of combustion	*Oleates*	9575.8	9629.2	9701.6	9761.5
20° (c_v) cal 15°/g	*Elaidates*	9570.3	9632.1	9697.0	9756.7

4. OXYGENATED DERIVATIVES OF THE AROMATIC SERIES

A. ALCOHOLS and PHENOLS

BENZYL ALCOHOL $C_6H_5.CH_2OH$

The pure compound is synthetized by catalytic hydrogenation of benzaldehyde in the presence of platinum oxide.

Constants: B.E. (1935). — **Polyphasic equilibria**

Saturated vapour pressure

t°	p mm	t°	p mm	t°	pmm	t°	p mm	
60.9	1	77.2	4	86.5	7	109.7	25	Kahlbaum (1894)
67.8	2	80.8	5	90.7	9	115.4	33	Kahlbaum and von Wirkner
72.9	3	83.9	6	92.6	10	124.4	50	„ (1894)
122.52	47.16	130.90	66.39	147.09	123.76	190.50	507.50	Dreisbach and Shrader
127.12	57.04	134.28	75.86	174.64	315.52			„ (1949)

Boiling point

205°25	$\frac{dt}{dp}$ *(10 mm):* 0°50	Lecat (passim)
205°35	„ 0°56	Louguinine (1898)
205°41	„ 0°4952	Dreisbach and Martin (1949)
205°45	„ 0°50	B.E. (1935)

Melting point

−15°19	Dreisbach and Martin (1949)
−15°3	B.E. (1935)
−15°5	Parks, Todd and Moore (1936)

Melting curve

t°	p kg/cm²	t°	p kg/cm²	
−15.3	1	− 5.0	682	Deffet (1940)
−10.0	365	0.0	1010	„

Constants of state

Density

t°	d		t°	d	
0	1.06095	B.E. (1935)	18	1.0486	Hebeisen (1925)
15	1.04927	„	25	1.04127	Martin and George (1933)
30	1.03765	„	0	1.0607	Walden (1908–09)
20	1.04535	Dreisbach and Martin	25	1.0415	„
25	1.04156	„ (1949)	50	1.0219	„

Viscosity

t°	$\eta \cdot 10^5$	
15	7760	B.E. (1935)
30	4650	„

Surface tension

t°	γ	
15	40.41	B.E. (1935)
20	29.96	„
30	38.94	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.53713	1.53783	1.54260	1.54285	1.55262	1.55508	1.56272	B.E. (1935)
$\frac{dn}{dt}$	0.00040	40	—	40	41	42	43	„
20	—	—	1.54035	—	—	—	—	DREISBACH and MARTIN (1949)
25	—	—	1.53837	—	—	—	—	
$\frac{dn}{dt}$	—	—	0.00040	—	—	—	—	„
25	—	—	1.53866	—	—	—	—	WALDEN (1907)

Heat constants

Specific heat: PARKS, TODD and MOORE (1936)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −183.16	0.1280	−133.16	0.1791	−63.16	0.2520	L. −13.16	0.4246
−173.16	0.1373	−123.16	0.1922	−53.16	0.2629	− 3.16	0.4325
−163.16	0.1467	−113.16	0.207	−43.16	0.2740	+ 6.84	0.4545
−153.16	0.1561	−103.16	0.228	−33.16	0.294	16.84	0.4694
−143.16	0.1673	−73.16	0.2410			26.84	0.4843

Heat of melting	19.83 cal 15°/g	PARKS, TODD and MOORE (1936)

TRIPHENYLCARBINOL $(C_6H_5)_3COH$

Freezing point and *specific heat:* SMITH and ANDREWS (1931).

PHENYLETHYLCARBINOL $C_6H_5.CHOH.C_2H_5$

The results of PICKARD and KENYON in 1911 do not agree, neither with their values of 1914, nor with the results of SMITH (1914), although the latter used PICKARD's sample. Moreover the density of SMITH's sample of *laevo* antipode disagrees with the density of the racemic compound prepared by another method. PICKARD, SMITH and DESCAMPS (1924) show a similar disagreement for methylphenylcarbinol: $CH_3.CHOH.C_6H_5$. The values for ethylnaphthylcarbinol ($C_2H_5.CHOH.C_{10}H_7$) and for hexylnaphthylcarbinol ($C_6H_{13}.CHOH.C_{10}H_7$), published by KENYON and PICKARD (1914), and the values for phenylbenzylcarbinol ($C_6H_5.CHOH.CH_2C_6H_5$) studied by GERRARD and KENYON (1928), must also be considered as rather dubious.

PHENYL-*n*-PROPYLCARBINOL: $C_6H_5.CHOH.n\text{-}C_3H_7$ and *l*-METHYLNAPHTHYLCARBINOL: $CH_3.CHOH.C_{10}H_7$: *melting point, density* and *rotatory power:* PICKARD and KENYON (1914) and KENYON and PARTRIDGE (1936).

PHENOLS

PHENOL C_6H_5OH

This product is purified by fractional distillation *in vacuo* and by fractional fusion. The criteria of purity are the constancy of the melting point and of the critical solution point in water for successive fractions.

Constants: B.E. (1937). — **Polyphasic equilibria**

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
5.4	0.050	10.2	0.085	14.7	0.132	28.5	0.48	Balson (1947)
6.6	0.055	11.4	0.095	22.2	0.272	32.3	0.667	,,
7.8	0.065	12.5	0.107					,,
44.8	1	59.4	4	67.8	7	71.8	9	Kahlbaum and von Wirkner (1898)
51.5	2	62.5	5	69.9	8	73.5	10	
55.8	3	65.3	6					,,
77.7	13.5	84.3	18.6	90.9	25.7	98.3	37.1	Kahlbaum (1897)
79.0	14.1	84.9	19.1	91.0	26.1	99.1	38.7	,,
79.3	14.4	85.0	19.2	91.4	26.5	99.4	39.3	,,
80.3	15.1	85.5	19.7	91.9	27.2	99.9	40.1	,,
80.5	15.2	85.7	19.9	92.4	28.0	100.6	41.3	,,
81.3	15.8	86.0	20.2	92.8	28.8	101.3	43.0	,,
81.4	15.9	86.1	20.3	93.3	29.3	101.5	43.3	,,
81.5	15.9	86.5	20.5	93.7	30.1	102.0	44.4	,,
82.1	16.5	86.7	21.0	94.0	30.3	102.6	45.5	,,
82.5	16.6	87.3	21.8	94.7	31.2	102.7	45.9	,,
82.6	16.9	87.4	22.1	95.4	32.2	103.6	47.3	,,
82.9	17.1	88.9	23.3	96.0	33.2	103.9	48.1	,,
83.5	18.0	89.1	23.7	96.7	34.8	104.4	49.3	,,
83.9	18.1	89.7	24.1	96.9	34.9	104.7	50.0	,,
84.1	18.3	90.3	24.9	97.5	35.9			,,
107.15	57.04	125.95	123.76	152.37	315.52	167.63	507.50	Dreisbach and Shrader (1949)
113.81	75.86							

Boiling point

181°75	$\frac{dt}{dp}$ *(10 mm)*: 0°4744 Dreisbach and Martin (1949)	182°	Pardee and Weinrich (1944)
181°9	Doliqué (1932)	182°2	$\frac{dt}{dp}$ *(10 mm)*: 0°48 B.E. (1937) and Lecat (passim)

Melting point

40°7	Deffet (1935)	40°85	Howell (1932)
40°71	Jones (1927)	40°85	Michel (1938)
40°71	Jones and Bury (1927)	40°87	Bridgman (1915)
40°75	B.E. (1937)	40°9	Parks, Huffman and Barmore (1933)
40°8	Friedländer (1904)	40°90	Dreisbach and Martin (1949)
40°85	Masse and Leroux (1916)	40°92	Hill and Malisoff (1926)
40°85	Dolique (1932)	41°	Pardee and Weinrich (1944)

Kendall asserts that the commercial product contains an impurity which raises the melting point.

Melting curve

t°	p kg/cm²	t°	p kg/cm²	
L. I 40.70	1	50.00	737	Deffet (1935)
42.60	155	52.50	930	„
45.10	348	53.00	971	„
47.50	540			„
L. I 40.87	1	L. II 62.1	2000	Bridgman (1915)
47.5	500	82.1	3000	„
53.4	1000	99.8	4000	„
58.7	1500	115.9	5000	„
63.3	2000	131.0	6000	„
		145.2	7000	„
L. I–II 0.0	1327	158.8	8000	„
20.0	1565	171.9	9000	„
40.0	1803	184.6	10000	„
60.0	2039	197.0	11000	„
		209.2	12000	„

Critical solution point in H_2O

65°85	Hill and Malisoff (1926)	66°3–66°4	B.E. (1937)
66°06	Friedländer (1904)	66°5	Dolique (1932)

Constants of State

Density

t°	d		t°	d	
45	1.05446	B.E. (1937)	50	1.0499	Howell (1932)
50	1.05021	„	60	1.0413	„
55	1.04604	„	70	1.0325	„
			45	1.0545	Bedson and Carleton-Williams (1881)

Viscosity

t°	$\eta \cdot 10^4$		t°	$\eta \cdot 10^4$	
45	407.6	B.E. (1937)	45	403.6	Thole (1910)
60	257.8	„	50	337	Dunstan, Hilditch and Thole (1913)

Surface tension

t°	γ	
50	35.77	B.E. (1937)
55	37.26	„
60	36.69	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
45	1.53421	1.53480	1.54027	1.54053	1.55117	1.55381	1.56225	B.E. (1937)
$\frac{dn}{dt}$	0.00049	50	—	50	51	52	52	„
40.6	—	1.53691	1.54247	—	—	1.55581	1.56840	Eisenlohr (1911)

The *density* and the *refractive index* of Dreisbach and Martin (1949) do not agree with the data of the other authors.

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −180.5	0.129	−101.9	0.191	−20.5	0.270	Parks, Huffman and Barmore (1933)
−174.5	0.134	− 81.4	0.209	−13.2	0.278	
−167.1	0.139	− 72.8	0.217	+ 3.9	0.306	„
−150.2	0.151	− 63.9	0.226	17.1	0.328	„
−136.0	0.162	− 36.4	0.252	22.6	0.338	„
−124.6	0.172					„
L. 90	0.561					Schlamp (1895)

Heat of melting	28.67 cal 15°/g	Steiner and Johnston (1928)

CRESOLS

Purified by alternate fractional distillation and fusion.

A very sensitive criterion of the purity of the cresols is the velocity of crystallization (Michel, 1938).

Ortho-CRESOL $o\text{-}CH_3.C_6H_4OH$

Constants. — Polyphasic equilibria

Velocity of crystallization: 10° 20.3 cm/min Michel (1938)

Saturated vapour pressure:

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
36.6	1	83.7	14	96.6	27	105.2	40	Kahlbaum (1898)
51.3	2	85.0	15	97.4	28	105.7	41	,,
57.3	3	86.3	16	98.1	29	106.3	42	,,
61.7	4	87.4	17	98.8	30	106.8	43	,,
65.5	5	88.6	18	99.5	31	107.4	44	,,
68.7	6	89.6	19	100.2	32	107.9	45	,,
71.3	7	90.6	20	100.9	33	108.4	46	,,
73.6	8	91.6	21	101.5	34	108.9	47	,,
75.7	9	92.5	22	102.2	35	109.9	49	,,
77.6	10	93.4	23	102.8	36	110.3	50	,,
79.3	11	94.3	24	103.4	37			,,
80.8	12	95.1	25	104.0	38			,,
82.3	13	95.9	26	104.6	39			,,
113.11	57.04	132.63	123.76	160.17	315.52	176.14	507.50	Dreisbach and Shrader (1949)
120.22	75.86							

Boiling point

190°95	$\frac{dt}{dp}$ *(10 mm)*: 0°4826 Dreisbach and Martin (1949)	191°5	Masse and Leroux (1916)
191°1	Lecat (passim)		

Melting point

30°35	Michel (1938)	30°5	Glass and Madgin (1934)
30°4	Deffet (1938)	30°60	Kendall and Beaver (1921)
30°45	Dawson and Mountford (1918)	30°8	Bridgman (1914)
		30°94	Dreisbach and Martin (1949)

Melting curve

t°	p kg/cm²	t°	p kg/cm²	
L. I 30.8	1	L. II 102.7	6000	Bridgman (1914)
47.4	1000	116.4	7000	„
61.9	2000	129.3	8000	„
74.2	3000	141.4	9000	„
81.8	4000	153.7	10000	„
94.5	5000	164.6	11000	„
102.9	6000	175.9	12000	„
110.8	7000			„
118.1	8000			„
L. II 30.4	1	40.00	592	Deffet (1938–40)
32.50	123	42.50	750	„
35.00	278	45.50	943	„

Density

t°	d		t°	d	
25	1.0414	Kendall and Beaver (1921)	41	1.02734	Dreisbach and Martin
			46	1.02298	„ (1949)
25	1.0415	Dawson and Mountford (1918)			

Viscosity $\eta \cdot 10^4$

25°	760.8	Kendall and Beaver

The *refractive index* of Dawson and Mountford (1918) and Dreisbach and Martin (1949) do not agree.

Meta-CRESOL $m\text{-}CH_3.C_6H_4OH$

Constants: B.E. (1937)

Velocity of crystallization: —10° 10.4 cm/min Michel (1938)

Boiling point

202°2	$\frac{dt}{dp}$ *(10 mm):* 0°52 Lecat (passim)
202°2	Pardee and Weinrich (1944)
202°70	„ 0°52 B.E. (1937)

Melting point *Melting curve*

		t°	p kg/cm²	
11°5	Pardee and Weinrich (1944)	11.90	1	Deffet (1938–40)
11°90	Deffet (1938)	17.50	422	„
11°96	B.E. (1937)	24.00	810	„

Density

t°	d		t°	d	
0	1.04998	B.E. (1937)	9	1.0425	Bolle and Guye (1905)
15	1.03803	„	55.4	1.0060	„
30	1.02598	„	9.5	1.04190	Schwers (1911)
0	1.0497	Pinette (1888)	20	1.0341	Richards and Mathews (1908)

Viscosity *Surface tension*

t°	$\eta \cdot 10^4$		t°	γ	
15	2466.6	B.E. (1937)	15	38.01	B.E. (1937)
30	980.7	„	20	37.56	„
			30	36.57	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.
15	1.53737	1.53802	1.54318	1.54344	1.55389	1.55644	1.56469
$\frac{dn}{dt}$	0.00044	43	—	44	45	45	46

Para-CRESOL $p\text{-}CH_3.C_6H_4OH$

Constants

Velocity of crystallization: 10° 23.4 cm/min. Michel (1938)

Saturated vapour pressure:

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
55.7	1	94.9	14	107.8	27	115.8	39	Kahlbaum (1898)
64.4	2	96.2	15	108.6	28	116.4	40	„
69.4	3	97.5	16	109.2	29	117.0	41	„
73.3	4	98.7	17	110.0	30	117.5	42	„
76.5	5	99.8	18	110.8	31	118.0	43	„
79.4	6	100.8	19	111.4	32	118.5	44	„
81.9	7	101.8	20	112.1	33	119.0	45	„
84.2	8	102.8	21	112.8	34	119.5	46	„
86.3	9	103.7	22	113.4	35	120.0	47	„
88.6	10	104.6	23	114.0	36	120.4	48	„
90.1	11	105.4	24	114.6	37	120.9	49	„
91.7	12	106.2	25	115.2	38	121.3	50	„
93.4	13	107.0	26					„
128.05	66.39	143.86	123.76	171.27	315.52	187.17	507.50	Dreisbach and Shrader (1949)
131.26	75.86							

Boiling point

201°7	Lecat (passim)	201°88	$\frac{dt}{dp}$ *(10 mm):* 0°4926 Dreisbach and Martin (1949)
201°8	Pinette (1888)	202°1	Pardee and Weinrich (1944)
		202°32	Gibbs (1927)

Melting point

34°4	da Silva (1934)	34°78	Dreisbach and Martin (1949)
34°55	Kendall and Beaver (1921)	34°8	Pardee and Weinrich (1944)
34°6	Michel (1938)		

Density:	25°	1.0295	Kendall and Beaver (1921)
	41°	1.01788	Dreisbach and Martin (1949)
	46°	1.01401	„
Viscosity: $\eta \cdot 10^4$	25°	1474	Kendall and Beaver (1921)
Refractive index:	$n_D^{40°}$	1.5316	Puschin and Matavulj (1932)
	$n_D^{41°}$	1.53115	Dreisbach and Martin (1949)
	n_D^{46}	1.52870	„
	$\frac{dn}{dt}$:	0.00049	„

CARVACROL or 2-METHYL-5-*iso*-PROPYLPHENOL

$CH_3.(CH_3)_2CH.C_6H_3OH$

Constants

Boiling point: 237°85 Lecat (passim)

Density

t°	d	
18.6	0.9774	Brühl (1899)
20	0.9760	„
21.4	0.9750	Eykman (1893)

Refractive index

t°	Li	Hα	D	Tl	Hβ	Hγ	
18.6	1.51926	1.52009	1.52450	1.52950	1.53581	1.54550	Brühl (1899)
21.4	—	1.51909	—	—	1.53485	—	Eykman (1893)

THYMOL or 5-METHYL-2-*iso*-PROPYLPHENOL $CH_3.(CH_3)_2CH.C_6H_3OH$

Constants

Saturated vapour pressure

t°	p mm		t°	p mm	
0	0.00046	Balson (1947)	30	0.0300	Balson (1947)
10	0.0023	„	40	0.0953	„
20	0.0087	„	50	0.282	„

Boiling point

232°9	Lecat (passim)

Melting point

49°6	Kendall (1916)
49°70	Reissert (1890)

Density

t°	d		t°	d	
51.4	0.9484	Schiff (1884)	9.6	0.9816	Eykman (1893)
54.9	0.9461	„	78.5	0.9274	„
64.0	0.9388	„	80.1	0.9257	„ (1919)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He bl.	He v	Hγ	
78.5	1.49125	1.49184	—	1.49618	1.50474	150688	1.50919	1.51356	1.51632	Eykman (1919)
9.6	—	1.52277	—	—	—	1.53865	—	—	—	„ (1893)
80.1	—	1.49127	—	—	—	1.50627	—	—	—	„
20	—	—	1.5228	—	—	—	—	—	—	Puschin and Matavulj (1932)
60	—	—	1.5044	—	—	—	—	—	—	

Para-THYMOL or 3-METHYL-4-*iso*-PROPYLPHENOL: $CH_3.(CH_3)_2CH.C_6H_3OH$ and *Para-iso*-PROPYLTHYMOL or 3-METHYL-4,6-DI-*iso*-PROPYLPHENOL: $CH_3[(CH_3)_2CH]_2C_6H_2OH$

Density and *refractive index:* Eykman (1919)

PYROCATECHOL or *Ortho*-DIHYDROXYBENZENE o-$C_6H_4(OH)_2$

Constants

Boiling point

245°6	Friend and Hargreaves (1946)

Melting point

104°	Belucci and Grassi (1913)
104°3	Andrews, Lynn and Johnston (1926)
105°	Friend and Hargreaves (1946)

Density and viscosity: Friend and Hargreaves (1946)

t°	d	$\eta \cdot 10^3$	t°	d	$\eta \cdot 10^3$	t°	d	$\eta \cdot 10^3$
121.0	1.1493	21.71	179.3	1.0902	8.932	220.6	1.0477	5.794
140.7	1.1297	15.01	190.0	1.0793	7.898	232.0	1.0353	5.152
160.0	1.1102	11.351	200.7	1.0680	7.024			
170.2	1.0999	9.954	210.1	1.0584	6.368			

Specific heat

L. 104°3	0.520	Andrews, Lynn and Johnston (1926)
C. 104°3	0.406	„
C. 25°	0.287	„

Heat of melting	49.40 cal 15°/g	Andrews, Lynn and Johnston (1926)

RESORCINOL or *Meta*-DIHYDROXYBENZENE $m\text{-}C_6H_4(OH)_2$

Constants

Boiling point

275°9	FRIEND and HARGREAVES (1946)

Melting point

109°7	ANDREWS, LYNN and JOHNSTON (1926)	110°1	GARELLI (1895)
110°	FRIEND and HARGREAVES (1946)	110°35	WALJASCHKO and SCHTSCHERBAK (1925)
110°1	SCHIFF (1884)		

Density and Viscosity: FRIEND and HARGREAVES (1946)

t°	d	$\eta \cdot 10^3$	t°	d	$\eta \cdot 10^3$	t°	d	$\eta \cdot 10^3$
141.0	1.1586	37.55	220.0	1.0890	9.348	250.1	1.0624	6.668
159.0	1.1430	24.93	231.2	1.0792	8.168	260.0	1.0535	6.012
183.0	1.1217	14.92	242.0	1.0693	7.296			
198.3	1.1079	12.14						

Specific heat

L. 109°7	0.522	ANDREWS, LYNN and JOHNSTON (1926)
C. 109°7	0.432	„
C. 25	0.284	„

Heat of melting	46.22 cal 15°/g	ANDREWS, LYNN and JOHNSTON (1926)

QUINOL or *Para*-DIHYDROXYBENZENE $p\text{-}C_6H_4(OH)_2$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
155.0	5.9	180.7	26.0	217.7	105.9	252.4	315.8	STELZNER (1901)
157.6	7.1	191.1	40.0	227.6	147.1	261.3	403.9	„
164.3	11.6	199.5	54.3	238.3	207.7	267.9	482.3	„
173.7	18.2	210.6	81.5					„

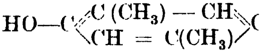
Melting point: 172°3 Andrews, Lynn and Johnston (1926)

Specific heat

L. 172°3	0.562	Andrews, Lynn and Johnston (1926)
C. 172°3	0.422	„
C. 25	0.304	„

Heat of melting	58.84 cal 15°/g	Andrews, Lynn and Johnston (1926)

4-n-PROPYL PYROCATECHOL: $C_6H_3(OH)_2(n\text{-}C_3H_7)$ (1,2,4): *density* and *refractive index:* Eykman (1919)
For some other phenols, see Pardee and Weinrich (1944)



p-XYLOQUINOL: $HO\!-\!C\!\begin{matrix}\diagup C(CH_3)-CH\diagdown \\ \diagdown CH = C(CH_3)\diagup\end{matrix}\!C\!-\!OH$: *Saturated vapour pressure:* Coolidge and Coolidge (1927).

B. PHENOL ETHERS

ANISOLE $C_6H_5OCH_3$

Constants: B.E. (1935)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
73.34	47.16	84.55	75.86	123.77	315.52	Dreisbach and Shrader (1949)
81.31	66.39	96.89	123.76	139.37	507.50	„

Boiling point

153°75	$\frac{dt}{dp}$ *(10 mm):*	0°4896	Dreisbach and Martin (1949)
153°83	„	0°47	B.E. (1935)
153°85			Lecat (passim)
153°9			Piatti (1930–31)

Melting point: −37°7 B.E. (1935) −37°38 Dreisbach and Martin (1949)

Density

t°	d		t°	d	
0	1.01243	B.E. (1935)	0	1.01237	Timmermans (1910)
15	0.99858	„	18	0.9956	Hebeisen (1925)
30	0.98462	„	25	0.98924	Martin and Collie (1932)
20	0.99402	Dreisbach and Martin	45	0.9707	Thole (1910)
25	0.98932	„ (1949)			

Viscosity

t°	$\eta \cdot 10^5$	
15	1152	B.E. (1935)
30	789	,,

Surface tension

t°	γ	
15	36.18	B.E. (1935)
20	35.45	,,
30	34.15	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.51389	1.51478	1.51961	1.51987	1.52972	1.53235	1.54015	
$\frac{dn}{dt}$	0.00049	50	50	50	51	51	52	
21	—	—	1.5168	—	—	—	—	Badoche (1941)
25	—	1.50992	—	—	—	—	—	Martin and Collie (1932)
20	—	—	1.51700	—	—	—	—	Dreisbach and Martin
25	—	—	1.51430	—	—	—	—	,, (1949)
$\frac{dn}{dt}$	—	—	0.00054	—	—	—	—	,,

Heat of combustion	17°, (c_v) 8185.2 cal 15°/g	Badoche (1941)

PHENETOLE $C_6H_5 . O . C_2H_5$

Constants:

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
91.89	57.04	98.94	75.86	139.17	315.52	Dreisbach and Shrader (1949)
95.60	66.39	111.56	123.76	155.16	507.50	,,

Boiling point: 170°00 Dreisbach and Martin (1949)

Melting point: −29°52 Dreisbach and Martin (1949)

−30°2 Timmermans

Density

t°	d	
0	0.9841	Ssachanow and Rjackowsky (1914)
15.7	0.9693	Eykman (1895)
77.6	0.9110	,,

t°	d	
20	0.96514	Dreisbach and Martin
25	0.96049	,, (1949)

Viscosity

t°	$n \cdot 10^5$	
0	1883	**Ssachanow** and **Rjackowsky** (1914)
25	1122	„ (1915)

The *refractive index* of **Eykman** and **Dreisbach** do not agree.

PHENYL-*n*-PROPYL ETHER: $C_6H_5.O.n\text{-}C_3H_7$ and PHENYL-*n*-BUTYL ETHER: $C_6H_5.O.n\text{-}C_4H_9$: **Friend** and **Hargreaves** (1944).

PHENYL CETYL ETHER:	$C_6H_5.O.n\text{-}C_{16}H_{33}$	**Eykman** (1919)
Para-THYMOL METHYL ETHER:	$CH_3.(CH_3)_2CH.C_6H_3OCH_3$	„
„ ETHYL „ :	———————— OC_2H_5	„
HYDROXYTHYMOL METHYL ETHER:	$CH_3.(CH_3)_2COH.C_6H_3OCH_3$	„
HYDROXY-*para*-THYMOL METHYL ETHER:	$CH_3.(CH_3)_2COH.C_6H_3OCH_3$	„

ANETHOLE or *p*-PROPENYLANISOLE *para* $CH_3.O.C_6H_4CH{=}CHCH_3$

Constants

Boiling point		*Melting point*	
235°18	**Orndorff** and **Morton** (1900)	22°32	**Block** (1911–12)
235°2	$\frac{dt}{dp}$ *(10 mm)*: 0°58 **Louguinine** (1905)	22°3–22°5	**Grimaux** (1896)
235°7	**Lecat** (passim)	22°5	**Orndorff** and **Morton** (1900)

Melting curve: **Block** (1913)

t°	p kg/cm²	t°	p kg/cm²	
22.27	1	59.09	1941	**Block** (1913)
31.31	401	68.02	2480	„
40.98	904	77.03	3153	„
49.61	1394			„

VERATROLE or *o*-DIMETHOXYBENZENE *ortho*-$C_6H_4(OCH_3)_2$

Constants

Boiling point

206°25	**Friend** and **Hargreaves** (1946)
206°8	**Lecat**

Melting point

22°31	**Block** (1913)	22°5	(st. form) **Deffet** (1940)
22°34	„ (1911–12)	20°9	(unst. form) „
22°5	**Cauwood** and **Turner** (1915)	22°53	**Paterno** (1896)
22°5	**Bruni** and **Amadori** (1910)	22°7	**Louguinine** and **Dupont** (1911)

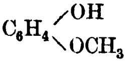
Melting curve

t°	p kg/cm²	t°	p kg/cm²	
Stab. 22.5	1	Unstab. 20°9	1	Deffet (1940)
25.00	139	25.00	248	„
30.00	400	30.00	507	„
35.00	665	35.00	802	„
37.00	763			„
39.50	890			„
Stab. 22.31	1	Stab. 58.40	1810	Block (1913)
30.65	343	67.91	2352	„
40.30	810	77.31	2941	„
49.05	1287			„

Density and Viscosity

t°	d	$\eta \cdot 10^3$	t°	d	$\eta \cdot 10^3$	
25	1.0819	—	151.4	0.9523	4.495	Friend and Hargreaves (1946)
53.2	1.0539	16.47	161.0	0.9418	4.131	„
72.5	1.0348	11.63	171.0	0.9305	3.788	„
92.8	1.0143	8.69	181.3	0.9186	3.483	„
112.2	0.9943	6.76	195.1	0.9027	3.133	„
131.0	0.9743	5.485				

Meta **and** *Para*-DIMETHOXYBENZENE: $C_6H_4(OCH_3)_2$.

Ortho, Meta and *Para*-METHOXYPHENOL: 
$C_6H_4\begin{matrix}/OH\\ \backslash OCH_3\end{matrix}$

Boiling and *melting points, density* and *viscosity:* Friend and Hargreaves (1946).

CREOSOL or 2-METHOXY-4-METHYLPHENOL: $CH_3.C_6H_3(OH).O.CH_3$
Boiling and *melting points, density* and *refractive index:* De Vries (1909).

EUGENOL $CH_2{=}CH.CH_2.C_6H_3(OCH_3)OH$ (1,3,4)

Constants

Boiling point:	254°8	Lecat (passim)
Melting point:	−9°15	Waterman and Priester (1929)
Density: 20°	1.0663	„

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.5359	1.5410	1.5543	1.5659	Waterman and Priester (1929)

Refractive index (continued)

	λ	I	II	
20°	Li 6708	1.5349	1.5350	Thompson (1933)
	Cd 6438	1.5366	1.5368	„
	D 5896	1.5411	1.5412	„
	Hg 5789	1.5419	1.5421	„
	Hg 5461	1.5454	1.5455	„
	Cd 5086	1.5506	1.5506	„
	Cd 4800	1.5554	1.5554	„
	Cd 4678	1.5579	1.5580	„
	Hg 4359	1.5655	1.5655	„

METHYLEUGENOL: $CH_2=CH.CH_2.C_6H_3(OCH_3)_2$ (B.P. Lecat), Eykman (1895-1919)
ETHYLEUGENOL: „ $(OCH_3)\,(OC_2H_5)$ „
METHYL-*Iso*-EUGENOL: $CH_3.CH=CH.C_6H_3(OCH_3)_2$ (B.P. „) „ „
SAFROLE: $CH_2=CH.CH_2.C_6H_3.O_2.CH_2$ (B.P. „) „ „
Iso-SAFROLE: $CH_3.CH=CH.C_6H_3.O_2.CH_2$ (B.P. „) „ „
Iso-PROPYLRESORCINOL DIMETHYLETHER: $(CH_3)_2CH.C_6H_3(OCH_3)_2$ „
Iso-PROPENYLRESORCINOL „ : $CH_2=C(CH_3).C_6H_3(OCH_3)_2$ „

DIPHENYL ETHER $(C_6H_5)_2O$

Constants

Boiling point:	258°31	Dreisbach and Martin (1949)
	259°0	Lecat
Freezing point:	26°85	Dodd and Hu Pak Mi (1949)
	26°90	Dreisbach and Martin (1949)
Triple point:	26°877	Schwab and Wickers (1949)

Density

t°	d		t°	d	
30	1.0662	Perrakis (1925)	30	1.06597	Dodd and Hu Pak Mi (1949)
30	1.06611	Dreisbach and Martin (1949)			

The authors do not agree at the other temperatures.

Viscosity: from 31° to 35°: Dodd and Hu Pak Mi (1949)

Refractive index

t°	D	t°	D	*dn/dt*	
30	1.57625	35	1.57387	0.00048	Dreisbach and Martin (1949)

C. ALDEHYDES, QUINONES, KETONES

BENZALDEHYDE $C_6H_5.CHO$

Constants

Saturated vapour pressure:

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
50.5	5.1	64.1	11.1	72.3	17.4	81.3	26.9	Kahlbaum and Wirkner
51.7	5.5	64.3	11.6	72.9	17.6	81.8	27.5	„ (1897)
52.3	5.6	65.1	11.9	73.3	18.0	82.1	27.9	„
53.5	6.2	65.3	12.1	73.7	18.4	82.4	28.4	„
54.0	6.3	66.1	12.6	73.9	18.9	83.2	29.5	„
55.1	6.7	66.8	13.1	74.7	19.5	83.5	29.9	„
55.8	6.9	67·9	13.8	75.1	20.0	83.9	30.5	„
56.5	7.4	68.8	14.3	75.5	20.5	84.7	31.7	„
57.9	8.0	68.9	14.4	76.7	21.4	85.2	32.5	„
59.1	8.6	69.3	14.7	77.0	21.9	85.9	33.5	„
59.3	8.6	69.4	14.8	77.5	22.4	86.1	33.7	„
60.5	9.1	70.3	15.5	77.8	22.6	86.6	34.4	„
61.5	9.6	71.1	16.2	78.4	23.4	87.2	35.5	„
61.8	9.7	71.3	16.2	78.7	23.7	87.8	36.4	„
62.1	10.1	71.7	16.3	79.3	24.4	88.5	37.4	„
62.4	10.2	72.1	16.7	80.2	25.5	88.6	37.6	„
63.5	10.7			81.1	26.6	88.8	37.9	„
63.7	10.8							„
29.3	1	46.6	4	55.7	7	62.0	10	Kahlbaum (1894)
37.2	2	50.1	5	58.0	8	95.3	50	„
42.5	3	53.0	6	60.1	9			„

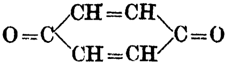
Boiling point

178°9	$\frac{dt}{dp}$ *(10 mm)*: 0°55	Louguinine (1898)
179°1		Paul and Schantz (1919)
179°2		Lecat (passim)

Freezing point

−55°6	Timmermans (passim)
−56°5	Biltz, Fischer and Wunnenberg (1930)

p-BENZOQUINONE



Constants

Saturated vapour pressure:

t°	p mm	t°	p mm	
−13.3	2.1	+0.5	10.2	Coolidge and Coolidge (1927)
−10.8	3.2	5.3	15.2	„

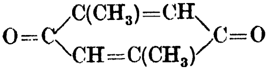
Melting point: 112°9 Andrews, Lynn and Johnston (1926)

Specific heat: cal 15°/g

L. 112°9	0.416	Andrews, Lynn and Johnston (1926)
C. 112°9	0.399	„
C. 25°	0.293	„

Heat of melting	40.79 cal 15°/g

p-XYLOQUINONE:



Saturated vapour pressure: see Coolidge and Coolidge (1927)

ACETOPHENONE $C_6H_5.CO.CH_3$

Purified by fractional distillation and fusion until constancy of the melting point and of the density for successive fractions.

Constants: B.E. (1935). — **Polyphasic equilibria**

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
79.5	10.3	86.7	14.5	91.1	17.9	95.3	21.8	Kahlbaum and Tesse (1898)
80.3	10.6	87.1	14.9	91.3	18.2	95.4	22.0	„
80.6	10.9	87.2	15.1	91.7	18.6	95.6	22.3	„
81.3	11.3	88.0	15.5	92.3	18.9	96.0	22.5	„
81.9	11.6	88.4	15.7	92.9	19.7	96.5	23.0	„
82.7	12.0	89.0	16.3	93.2	19.7	96.6	23.2	„
83.8	12.6	89.2	16.4	93.4	20.0	96.9	23.5	„
84.3	12.9	89.5	16.6	94.2	20.5	97.4	24.0	„
85.0	13.5	90.3	17.2	94.5	21.1	97.7	24.4	„
85.4	13.8	90.4	17.3	95.1	21.6			„

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	
98.7	25.4	103.4	31.2	107.5	37.4	111.6	44.4	Kahlbaum and Tesse (1898)
99.1	26.0	103.7	31.6	107.9	38.0	111.9	44.8	„
99.5	26.4	103.9	32.0	108.2	38.4	112.2	45.4	„
100.0	26.9	104.5	32.9	108.7	39.3	112.7	46.3	„
100.8	27.9	104.9	33.3	109.3	40.3	112.8	46.5	„
101.0	28.0	105.6	34.4	109.6	40.8	113.4	47.6	„
101.4	28.6	105.9	35.0	109.9	41.3	114.0	48.6	„
101.5	28.8	106.6	35.8	110.3	42.0	114.5	49.5	„
102.3	29.9	107.0	36.4	110.5	42.3	114.6	49.8	„
103.1	30.9	107.1	36.8	111.0	43.3	114.9	50.4	„
60.05	3.112	85.4	12.8	100.3	26.8			Ham, Churchill and Ryden
81.2	10.2	87.7	15.4					„ (1918)

Boiling point

202°	Perkin (1896)
202°0	Grimm and Patrick (1923)
202°0	$\frac{dt}{dp}$ *(10 mm)*: 0°55 Lecat (passim) and B.E. (1935)

Melting point

19°55	Walden and Birr (1933)
19°60	B.E. (1935) and Deffet (1935)
19°655	Morgan and Lammert (1924)
20°0	Louguinine and Dupont (1911)

Melting curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²
19.60	1	35.00	736
25.05	266	40.00	973
30.00	500		

Transition curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²
16.8	1	30.00	650
21.50	230	35.00	895
25.00	410	37.50	1015

Constants of state

Density

t°	d		t°	d	
15	1.03236	B.E. (1935)	55.6	0.9973	Dutoit and Friederich
20	1.02810	„	64.4	0.9890	„ (1900)
30	1.01947	„	77.1	0.9778	„
25	1.02382	Morgan and Lammert (1924)	91.9	0.9642	„
			114.2	0.9434	„
25	1.0237	Sugden (1933)			

Density (continued)

t°	d		t°	d	
5	1.0408	PERKIN (1896)	30	1.0194	PERKIN (1896)
7	1.0390	,,	35	1.0150	,,
10	1.0364	,,	40	1.0106	,,
15	1.0320	,,	45	1.0063	,,
20	1.0278	,,	50	1.0021	,,
25	1.0236	,,	55	0.9978	,,

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	2015	B.E. (1935)	30.15	1512.3	GIUA and GUASTALLA
30	1511	,,	34.50	1399.2	,, (1933)
18.70	1874.2	GIUA and GUASTALLA	37.85	1321.4	,,
21.30	1780.1	,, (1933)	42.30	1229.2	,,
25.50	1642	,,	44.50	1192.2	,,
28.40	1555	,,	48.10	1132.0	,,

Surface tension

t°	γ	
15	40.09	B.E. (1935)
20	39.50	,,
30	38.21	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.53003	1.53075	1.53631	1.53657	1.54788	1.55080	1.55993	—	B.E. (1935)
$\frac{dn}{dt}$	0.00044	45	—	46	46	46	47	—	,,
20	—	1.52876	1.53423	—	—	—	—	1.56027	BRÜHL (1894)
20	1.52767	—	—	1.53406	1.54525	—	1.55700	—	FEUSSNER (1927)
$\frac{dn}{dt}$	0.000457	—	—	462	473	—	483	—	,,

For other wave-lengths, see: FEUSSNER (1927)

n-BUTYL PHENYLKETONE:	n-$C_4H_9.CO.C_6H_5$	Yu, Shen and Wood (1940)
n-AMYL ,,	n-$C_5H_{11}.CO.C_6H_5$	,, and Simon (1929)
n-HEXYL ,,	n-$C_6H_{13}.CO.C_6H_5$	Yu, Shen and Wood (1940) and Deffet (1931)
n-OCTYL ,,	n-$C_8H_7.CO.C_6H_5$	Yu, Shen and Wood (1940)
n-UNDECYL ,,	n-$C_{11}H_{23}.CO.C_6H_5$	,,
n-TRIDECYL ,,	n-$C_{13}H_{27}.CO.C_6H_5$	,,

BENZOPHENONE $C_6H_5.CO.C_6H_5$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
301.9	701	305.8	759.7	306.4	768.5	Finck and Wilhelm (1925)
302.1	703.9	306.1	764.3	308.3	799.1	,,
304.1	732.5					,,
200.50	47.16	215.46	75.86	266.87	315.52	Dreisbach and Shrader
206.42	57.04	231.57	123.76	287.23	507.50	,, (1949)
211.16	66.39					,,

Boiling point

305°82	Callendar and Griffiths (1891)	306°06	Aten (1912)
305°84	Finck and Wilhelm (1925).	306°08	$\frac{dt}{dp}$ (10 mm): 0°636 Griffiths (1891)
305°89	Holborn and Henning (1911)	306°1	Perkin (1896)
305°9	Day and Sosman (1912)	306°10	,, 0°6214 Dreisbach and Martin (1949)

Melting point

48°00	Deffet (1935)	48°1	Mac Neight and Smyth (1936)
48°05	B.E. (unpublished)	48°11	Tammann (1903)
48°05	Hulett (1899)	48°1–2	Grinakowsky (1913)
48°05	Block (1911–12)		

Melting curve

t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²	
48.05	1.033	51.00	103.3	53.15	180.775	55.30	258.250	Hulett (1899)
48.80	25.825	51.45	129.125	53.95	206.6	56.05	284.075	,,
49.55	51.650	52.35	154.950	54.60	232.425	56.75	509.9	,,
50.30	77.475							,,
48.00	1	55.0	246	65.0	620	74.0	962	Deffet (1935)
51.0	102	60.0	440	70.0	814	75.0	1000	,,

Density

t°	d	t°	d	t°	d	t°	d	
50	1.0846	65	1.0722	80	1.0596	90	1.0518	Perkin (1896)
55	1.0805	70	1.0681	85	1.0557	95	1.0479	,,
60	1.0765	75	1.0637					,,

Dielectric constant: At different temperatures and for different frequencies, see: Mac Neight and Smyth (1936).

Heat of combustion	20° (c_v) 8538.1 cal 15°/g 20° (c_p) 8521.6 ,,	Landrieu and Blatt (1924) ,,

BENZYLIDENEACETONE:	$C_6H_5.CH{=}CH.CO.CH_3$	*Dsneity, refractive index* and *surface tension:* Getman (1910–11)
STYRYLETHYLKETONE:	$C_6H_5.CH{=}CH.CO.C_2H_5$	
BENZYLIDENEPINACOLINE:	$C_6H_5.CH{=}CH.CO.C(CH_3)_3$	
1,2-DIBENZOYLETHANE:	$C_6H_5.CO.CH_2.CH_2.CO.C_6H_5$	*Heat constants:* Parks and Huffman (1930)
1,2-DIBENZOYLETHYLENE:	$C_6H_5.CO.CH{=}CH.CO.C_6H_5$	

BENZOYLACETONE: $C_6H_5.CO.CH_2.CO.CH_3$: *Melting point, density* and *magnetic rotatory power:* Perkin (1892).

QUINIZARIN: $C_6H_4(CO)_2C_6H_2(OH)_2$: *Saturated vapour pressure and melting point:* Wenzel and Pirak (1934)

D. ACIDS

BENZOIC ACID $C_6H_5.CO_2H$

Quantitative determination of water as an impurity: Schwab and Wichers (1944).

Constants. — Polyphasic equilibria

Saturated vapour pressure

t°	p mm	t°	p mm	
C. 104	1.8	L. 130	9.3	Hirsbrunner (1934)
110	2.75	138	13.8	”
116	4.4			”
C. 60.1	0.0527	L. 158.2	34.0	Khosky, Wood and Flanigan (1927)
80.4	0.308	187.6	110.8	”
100.2	1.436			”
121.0	5.830			”
L. 175.5	71.1	212.7	262.9	Stelzner (1901)
188.6	114.1	238.9	570.0	”
200.5	173.8	248.7	730.0	”
207.4	219.8			”

Boiling point

249°2	Lumsden (1905)
250°03	$\frac{dt}{dp}$ (10 mm): 0°595 Burriel-Marti (1930)
250°8	Lecat (passim)

Melting point

122°305	Jessup and Green (1934)
122°375	Schwab and Wickers (1945)
122°43	Burriel-Marti (1930)

Triple point

122°362	Schwab and Wichers (1945)

Constants of state

Density

t°	d		t°	d	
L. 130	1.07490	Burriel-Marti (1930)	C. 28	1.316	Jessup (1946)
155	1.05218	”			
180	1.02942	”			

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
C. −180.26	0.120	−111.66	0.169	−44.06	0.225	PARKS, HUFFMAN and BARMORE
−174.46	0.125	−98.96	0.179	−38.56	0.230	„ (1933)
−167.66	0.130	−85.16	0.191	−17.06	0.248	„
−151.96	0.141	−70.66	0.204	+3.44	0.267	„
−137.66	0.151	−64.46	0.208	21.94	0.284	„
−124.26	0.160					„
L. 121°8	0.518	ANDREWS, LYNN and JOHNSTON (1926)				
C. 121°8	0.351	„				
C. 25°	0.304	„				

Heat of melting	121°8 33.89 cal 15°/g	ANDREWS, LYNN and JOHNSTON (1926)
Heat of combustion	20°, (c_v) 6319 „	BECKERS (1931)
	25°, (c_v) 6317.5 „	DICKINSON (1915)
	25°, (c_v) 6317.5 „	JESSUP (1942)
	25°, (c_v) 6317.8 „	JESSUP (1946)
	25°, (c_v) 6317.81 „	PROSEN and ROSSINI (1944)

SERIJAN, HIPSHER and GIBBONS (1949) have studied the *o, m, p-tert.* butylbenzoic acids.

5-PHENYLPENTEN(3)OIC ACID: $C_6H_5.CH_2.CH{=}CH.CH_2.CO_2H$: *Density* and *refractive index:* EYKMAN (1919).

Ortho-HYDROXYBENZOIC ACID (SALICYLIC ACID) $o\text{-}C_6H_4OH.CO_2H$

Purification and influence of water on its solubility: COHEN and VAN DOBBENBURGH (1925).

Constants

Saturated vapour pressure

t°	p mm		t°	p mm	
182.9	61.8	STELZNER (1901)	219.8	260.1	STELZNER (1901)
208.6	171.1	„	224.1	301.7	„
214.8	215.1	„			

Melting point

158°3	CROCKFORD and ZURBURG (1930)

Heat of combustion	20° (c_v) 5237.4 cal 15°/g	ROTH and LASSE (1924)
	„ „ 5233.8 „	BERNER (1925–27)
	„ „ 5237.2 „	VERKADE and COOPS (1928)
	„ „ 5234.9 „	KEFFLER (1931)
	„ „ 5237.2 „	BECKERS (1931)
	„ „ 5236.4 „	BADOCHE (1937)

GALLIC ACID: $C_6H_2(OH)_3.CO_2H$; TEREPHTHALIC ACID: p-$C_6H_4(CO_2H)_2$: *Saturated vapour pressure:* HIRSBRUNNER (1934).

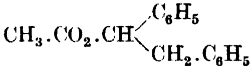
PHTHALIC ACID o-$C_6H_4(CO_2H)_2$

Specific heat: PARKS, TODD and MOORE (1936).

Heat of combustion: RICHARDSON and PARKS (1939); VERKADE (1926) and VERKADE and HARTMAN (unp.).

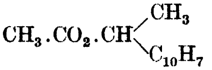
E. ESTERS

ESTERS of METHYLBENZYLCARBINOL: $C_6H_5.CH_2.CH(CH_3).O.COR$ ($R = CH_3 \rightarrow C_{17}H_{35}$): *Boiling point, density* and *rotatory power:* KENYON and PICKARD (1914).



l-PHENYLBENZYLCARBINYL ACETATE: $CH_3.CO_2.CH\begin{cases}C_6H_5\\CH_2.C_6H_5\end{cases}$: *Density* and *rotatory power:* GERRARD and KENYON (1928).

m-CRESYL ACETATE: $CH_3.CO_2.C_6H_4.CH_3$: *Saturated vapour pressure:* BALSON (1947).



NAPHTYLMETHYLCARBINYL ACETATE: $CH_3.CO_2.CH\begin{cases}CH_3\\C_{10}H_7\end{cases}$ and ESTERS of NAPHTYLHEXYLCARBINOL: $C_{10}H_7.CH(C_6H_{13}).O.COR$ ($R=CH_3 \rightarrow C_{10}H_{21}$): *Boiling point, density* and *rotatory power:* KENYON and PICKARD (1914).

METHYL BENZOATE $C_6H_5.CO_2CH_3$

Constants: B.E. (1935)

Saturated vapour pressure: KAHLBAUM and TESSE (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
60.6	4	100.5	30	104.1	35	107.2	40
64.4	5	101.3	31	104.7	36	107.8	41
67.7	6	102.0	32	105.4	37	108.3	42
77.3	10	102.8	33	106.0	38	108.9	43
96.3	25	103.4	34	106.6	39	112.6	50

Boiling point *Freezing point*

199°2	Crymble, Stewart, Wright and Glendinning (1911)
199°4	$\frac{dt}{dp}$ *(10 mm):* 0°54 Lecat
199°50	,, 0°54 B.E. (1935)

−12°4	(stable form)	B.E. (1935)
−13°9	(unstable form)	,,
−12°5		Jaeger (1917)

Melting curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²
−12.10	1	5.00	865
− 5.00	357	7.00	967
0.00	609		

Density

t°	d		t°	d	
0	1.10767	B.E. (1935)	4	1.1035	Perkin (1896)
15	1.09334	,,	5	1.10259	,,
30	1.07901	,,	10	1.09823	,,
20	1.0888	Gartenmeister (1890)	15	1.09325	,,
25	1.08396	Reid (1910)	20	1.08847	,,
			25	1.08772	,,

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$	
15	2298	B.E. (1935)
30	1673	,,
20	2051	Gartenmeister (1890)

t°	γ	
15	38.75	B.E. (1935)
20	38.14	,,
30	36.91	,,

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.51364	1.51455	1.51950	1.52963	1.53227	1.54011
$\frac{dn}{dt}$	0.00044	46	46	46	48	48

Magnetic rotatory power: 11°5 1.8523 Perkin (1896)

ETHYL BENZOATE $C_6H_5.CO_2\,C_2H_5$

Constants: B.E. (1935)

Boiling point

212°40	$\frac{dt}{dp}$ *(10 mm)*: 0°57	B.E. (1935)
212°45	„ 0°54	Kurbatow (1903)
212°5	„ 0°57	Lecat (passim)

Freezing point: —34°7 B.E. (1935)

Density

t°	d		t°	d	
0	1.06498	B.E. (1935)	12.5	1.0535	Kreman, Meingast and Gugl (1914)
15	1.05112	„			
30	1.03718	„	24.3	1.0426	„
4	1.0614	Perkin (1896)	26.3	1.0407	„
5	1.06049	„	33.2	1.0346	„
10	1.05591	„	46.8	1.0222	„
15	1.05138	„	56.8	1.0130	„
20	1.04684	„	57.5	1.0125	„
25	1.04214	„	67.1	1.00360	„
15	1.0509	Lumsden (1905)	69	1.0016	„
15	1.0510	Matsuno and Han (1933)			
25	1.0417	Reid (1910)			

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	2407	B.E. (1935)	15	35.94	B.E. (1935)
30	1751	„	20	35.31	„
11	2705	Kremann, Meingast and Gugl (1914)	30	34.12	„
12	2566	„			
64	751	„			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.50226	1.50291	1.50748	1.50774	1.51704	1.51926	1.52672	B.E. (1935)
$\frac{dn}{dt}$	0.00039	39	—	41	41	41	42	„
20	—	—	1.50570	—	—	—	—	Dummer (1919)

Magnetic rotatory power: 12°9 1.7533 Perkin (1896)

Iso-BUTYL BENZOATE: $C_6H_5.CO_2\,CH_2.CH\,(CH_3)_2$: *Boiling point:* LECAT; *density* and *magnetic rotatory power:* PERKIN (1896).

d-sec-BUTYL, HEXYL, OCTYL, NONYL, UNDECYL BENZOATES: $C_6H_5.CO_2R$ ($R{=}C_4H_9$, C_6H_{13}-, C_8H_{17}-, C_9H_{19}-, $C_{11}H_{23}$-*sec*)*: Boiling point, density, refractive index* and *rotatory power:* KENYON and PICKARD (1915)

BENZYLMETHYLCARBINYL BENZOATE: $C_6H_5CO_2CH(CH_2C_6H_5)(CH_3)$: *Boiling point, density, refractive, index* and *rotatory power:* KENYON and PICKARD (1915).

Sec. β-OCTYL ESTERS of *o, m, p*-TOLUIC ACIDS: *o, m, p*-$CH_3C_6H_4.CO_2\,C_8H_{17}$: *Boiling point* and *density:* RULE, HAY, NUMBERS and PATERSON (1928).

ETHYL CINNAMATE $C_6H_5.CH{=}CH.CO_2C_2H_5$

Constants

Boiling point | *Melting point*

271°0	WEGER (1883)	6°70	WALDEN and SWINNE (1912)
272°0	LECAT		

Density

t°	d		t°	d	
12.9	1.05560	PERKIN (1892)	16.8	1.0519	AUWERS (1917)
91.1	0.98815	,,	20.0	1.0490	BRÜHL (1886–96–97)

Refractive index

t°	Hα	D	Hβ	Hγ	
16.8	1.55355	1.56118	1.58223	1.60250	AUWERS (1917)
20	—	1.5597	—	—	,,
12.9	1.55508	1.56351	1.58466	—	PERKIN (1892)
91.1	1.51797	1.52500	1.54422	—	,,
20	1.55216	1.55982	1.58043	1.60053	BRÜHL (1896–97)

n-PROPYL PHENYLCINNAMATE: $C_6H_5CH{=}C(C_6H_5)CO_2n\text{-}C_3H_7$; METHYL *allo*-CINNAMYL ACRYLATE: $C_6H_5CH{=}CH.CH{=}CH.CO_2CH_3$: *Density, refractive index:* EYKMAN (1919).

NAPHTHOIC ESTERS $C_{10}H_7CO_2R$

sec.-BUTYL; HEXYL; HEPTYL; OCTYL; NONYL; DECYL; UNDECYL NAPHTHOATES: ($R{=}sec\text{-}C_4H_9$; C_6H_{13}; C_7H_{15}; C_8H_{17}; C_9H_{19}; $C_{10}H_{21}$; $C_{11}H_{23}$); BENZYLMETHYLCARBINYL NAPHTHOATE: ($R = C_6H_5.CH_2.CH(CH_3)$: *Boiling point, density, refractive index* and *rotatory power:* Kenyon and Pickard (1915).

DIETHYL PHTHALATE $C_6H_4(CO_2C_2H_5)_2$

Constants: B.E. (unp.)

Boiling point: 289°5 Brühl (1894)

Density

t°	d		t°	d	
0	1.13592	B.E. (unp.)	14.3	1.1232	Brühl (1894)
15	1.12276	,,	17.8	1.1202	Auwers and Schmidt (1913)
30	1.10958	,,			

Viscosity

t°	$\eta \cdot 10^5$	
15	15934	B.E. (unp.)
30	8742	,,

Surface tension

t°	γ		t°	γ	
15	38.01	B.E. (unp.)	20.5	37.34	Harkins, Brown and Davies (1917)
20	37.41	,,			
30	36.39	,,			

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	Hγ	
14.3	—	1.50070	1.50490	—	—	—	1.52498	Brühl (1894)
15	1.49937	1.49993	—	1.50431	1.51269	1.51483	—	B.E. (unp.)
$\frac{dn}{dt}$	0.00041	41	—	41	42	43	—	,,
17.7	—	1.49890	1.50293	—	—	1.51356	1.52284	Auwers and Schmidt (1917)

METHYL, ETHYL and *n*-PROPYL MANDELATES: $C_6H_5.CHOH.CO_2R$ ($R{=}CH_3$, C_2H_5, $n\text{-}C_3H_7$): *Boiling point, density* and *rotatory power:* Walker (1909).

sec.-OCTYL *o,m,p*-METHOXYBENZOATES $o,m,p\text{-}CH_3O.C_6H_4.CO_2sec\text{-}C_8H_{17}$: *Density* and *rotatory power:* Rule and Numbers (1926).

METHYL SALICYLATE $o\text{-}C_6H_4OH.CO_2CH_3$

Constants

Saturated vapour pressure: Ramsay and Young (1887)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	t°	p mm
175	215	185	287.8	195	378.9	205	491.7	215	630.15
176	221.65	186	296.0	196	389.15	206	504.35	216	645.55
177	228.3	187	304.45	197	399.6	207	517.25	217	661.25
178	235.15	188	313.05	198	410.3	208	530.4	218	677.25
179	242.15	189	321.85	200	421.2	209	543.8	219	693.6
180	249.35	190	330.85	201	432.35	210	557.5	220	710.2
181	256.7	191	340.05	202	443.75	211	571.45	221	727.05
182	264.2	192	349.45	203	455.35	212	585.7	222	744.35
183	271.9	193	359.05	204	467.25	213	600.25	223	761.9
184	279.75	194	368.85	205	479.35	214	615.05	224	779.85

Boiling point

222°88	Griffiths (1891) $\frac{dt}{dp}$ *(10 mm):* 0°57
222°9	Ramsay and Young (1887)
222°95	Lecat
223°03	Callendar and Griffiths (1891)

Freezing point: —8°6 Timmermans

Density

t°	d		t°	d	
4	1.1992	Perkin (1896)	15	1.1881	Perkin (1896)
5	1.1981	„	20	1.1834	„
10	1.1930	„	25	1.1788	„

Magnetic rotatory power: 15°8 2.0071 Perkin (1896)

PHENYL SALICYLATE or SALOL $o\text{-}C_6H_4OH.CO_2C_6H_5$

Melting point

41°2	Francis and Collins (1936)	41°7	Deffet (1935)
41°38	Campetti (1912–1913)	42°5	Miers and Isaac (1907)

Melting curve: Deffet (1935)

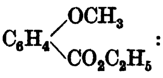
Stable form		*Unstable form II*		*Unstable form V*	
t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²
41.70	1	38.8	1	(12.9)	1
50.00	315	40.00	49	17.50	192
55.00	508	45.00	245	20.00	296
60.00	702	50.00	423	22.50	400
65.00	898	55.00	426	25.00	505
67.00	975	60.00	830	30.00	706
				33.00	827
				35.00	910
				36.60	980

Density

t°	d	
45	1.17858	Burriel-Marti (1930)
55	1.16981	„
75	1.1526	„

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
45	746.0	Burriel-Marti (1930)	45	41.53	Burriel-Marti (1930)
60	482.3	„	60	38.86	„

ETHYL METHYLSALICYLATE: 
$C_6H_4\begin{smallmatrix}OCH_3\\CO_2C_2H_5\end{smallmatrix}$: *Boiling point, density* and *magnetic rotatory power:* Perkin (1896)

DIMETHYL and DIETHYL MONOBENZOYLTARTRATES: *Melting point, density*
$(RCO_2)_2.CHOCOC_6H_5.CHOH$ $(R=CH_3;\ C_2H_5)$ and *rotatory power:*
DIMETHYL and DIETHYL DIBENZOYLTARTRATES: Wood and Nicholas
$(RCO_2.CHOCOC_6H_5)_2$ „ (1928)

5. OXYGENATED DERIVATIVES OF POLYMETHYLENES

Cyclo-PENTANOL C_5H_9OH

This compound is prepared by hydrogenation of cyclopentanone with platinum blak as a catalyst.

Constants: B.E. (1937)

Boiling point

140°85	$\frac{dt}{dp}$ *(10 mm):* 0°41 B.E. (1937) and LECAT (passim)

Freezing point: —19°0

Density			*Viscosity*			*Surface tension*		
t°	d		t°	$\eta \cdot 10^5$		t°	γ	
0	0.96253		15	14080		15	33.60	
15	0.95078		30	7596		20	33.07	
30	0.93908					30	32.12	

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.
15	1.45252	1.45286	1.45512	1.45529	1.45974	1.46090	1.46148
$\frac{dn}{dt}$	0.00046	46	—	47	47	47	47

1-METHYL-*cyclo*-PENTANOL-1 $CH_3.C_5H_8OH$

Prepared by GRIGNARD's synthesis from cyclopentanone and methylmagnesium bromide. It decomposes on boiling (dehydration).

Constants: B.E. (1937)

Freezing point: 35°50

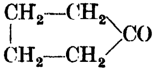
Density				*Viscosity*		*Surface tension*	
t°	d	t°	d	t°	$\eta \cdot 10^5$	t°	γ
36	0.90652	45	0.89747	36	6731	36	28.19
40	0.90253	50	0.89251	45	4585	40	27.80
						45	27.22

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
40	1.43855	1.43871	1.44125	1.44547	1.44649	1.44981
$\frac{dn}{dt}$	0.00047	47	49	47	45	48

DIALKYL-*cyclo*-PENTANOLS 1: .$C_5H_7OH(R_2)[(R)_2=(CH_3)_2;\ (C_2H_5)_2;\ (CH_3,\ n\text{-}C_3H_7)]$: *Melting point, density, viscosity* and *refractive index:* CHIURDOGLU (1933–34–35).

Cyclo-PENTANONE



Cyclopentanone is prepared by condensation of adipic acid by means of baryta.

Constants: B.E. (1937)

Boiling point

130°65	$\frac{dt}{dp}$ *(10 mm):* 0°48 B.E. (1935) and LECAT

Freezing point: —51°3

Density

t°	d	
0	0.96800	
15	0.95353	
30	0.93902	

Viscosity

t°	$\eta \cdot 10^5$	
15	2253	
30	995	

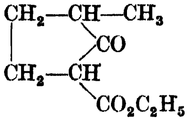
Surface tension

t°	γ	
15	34.37	
20	33.87	
30	32.58	

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.43645	1.43679	1.43934	1.44379	1.44498	1.44845
$\frac{dn}{dt}$	0.00042	40	42	42	42	42

METHYL-*cyclo*-PENTANONE ETHYL CARBOXYLATE



Constants: CHIURDOGLU (1935)

Boiling point: 111°0/16 mm; 109°5/15 mm

Density: 0° 1.06386; 20° 1.04516 *Viscosity* $\eta \cdot 10^5$: 15° 5103; 30° 3407

Refractive index: 20° Hα: 1.44430; He y.: 1.44667; Hβ: 1.45242; Hγ: 1.45697

Cyclo-HEXANOL $C_6H_{11}OH$

Prepared from pure phenol by catalytic hydrogenation (platinum) and purified by distillation under reduced pressure until constancy of the melting point and of the density for successive fractions.

Constants: B.E. (1937)

Boiling point

160°8	$\frac{dt}{dp}$ *(10 mm):* 0°45 Lecat
161°10	„ 0°45 B.E. (1937)
161°3	Nagornow and Rotinjanz (1911)

Melting point

25°15	B.E. (1937)
25°45	Deffet (1940)
25°46	Lange (1932)

Melting curve

t°	p kg/cm²		t°	p kg/cm²	
25.45	1	Deffet (1940)	50.00	685	Deffet (1940)
30.00	133	„	60.00	968	„
40.00	400	„			

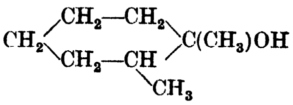
Density *Viscosity* *Surface tension*

t°	d	t°	$\eta \cdot 10^5$	t°	γ	
30	0.94155	30	41067	25.5	33.91	B.E. (1937)
45	0.92994	45	17194	30	33.47	„
				40	32.24	

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.
25	1.46201	1.46246	1.46477	1.46494	1.46947	1.47063	1.47422
$\frac{dn}{dt}$	0.00038	38	—	38	38	39	40

1,2-DIMETHYL-*cyclo*-HEXANOL-1



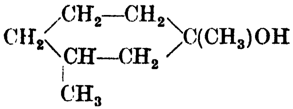
Constants: CHIURDOGLU (1938)

		Trans			*Cis*		
Boiling point/25mm		74°0			82°85		
Freezing point		13°2			23°2		
Density:	15°	0.92346			—		
	20°	0.91874			0.92504		
	30°	0.90940			0.91692		
	40°	0.90000			0.90882		
Viscosity: $\eta \cdot 10^5$	15°	24520			—		
	20°	17258			—		
	30°	9143			25424		
	40°	5466			13500		
Refractive index		20°	30°	$\frac{dn}{dt}$	20°	30°	$\frac{dn}{dt}$
	Hα	1.45903	1.45416	0.00049	1.46252	1.45826	0.00043
	He y.	1.46145	1.45650	49	1.46494	1.46059	43
	Hβ	1.46712	1.46211	50	1.47058	1.46617	44
	Hγ	1.47176	1.46669	51	1.47530	1.47083	45

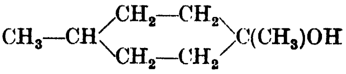
Other DIMETHYL-*cyclo*-HEXANOLS-1

Constants: CHIURDOGLU (1938)

1,3-DIMETHYL



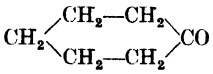
1,4-DIMETHYL



	1,3-DIMETHYL *Trans*		1,3-DIMETHYL *Cis*		1,4-DIMETHYL *Cis*	
Boiling point /25 mm	77°55		84°0		83°75	
Freezing point	14°5		27°5		24°	
Density	0°	0.91366	30°	0.90216	30°	0.90112
	15°	0.91052	40°	0.89358	40°	0.89290
	20°	0.89748	45°	0.88930	45°	0.88880
	30°	0.88936	50°	0.88502		
	40°	0.88124				
Viscosity: $\eta \cdot 10^5$	15°	41898	30°	19774	30°	21740
	20°	28421	40°	10881	40°	11567
	30°	14009	45°	8331	45°	8828
	40°	7649	50°	6534		

	1,3-DIMETHYL-*cyclo*-HEXANOL-1				1,4-DIMETHYL-*cyclo*-HEXANOL-1	
	Trans		*Cis*		*Cis*	
Refractive index: 20°		$\frac{dn}{dt}$		$\frac{dn}{dt}$		$\frac{dn}{dt}$
Hα	1.45073	—	1.45753	—	1.45643	—
He y.	1.45317	—	1.45996	—	1.45887	—
Hβ	1.45880	—	1.46564	—	1.46455	—
Hγ	1.46347	—	1.47029	—	1.46920	—
30°						
Hα	1.44651	0.00042	1.45304	0.00045	1.45213	0.00043
He y.	1.44897	42	1.45547	45	1.45457	43
Hβ	1.45462	42	1.46108	45	1.46029	43
Hγ	1.45923	42	1.46575	45	1.46486	43

Cyclo-HEXANONE



Constants: B.E. (1937)

Boiling point *Freezing point*

155°65	$\frac{dt}{dp}$ *(10 mm):* 0°48	−31°2	TIMMERMANS
155°7	„ 0°48 LECAT		

Density

t°	d		t°	d	
0	0.96435	B.E. (1937)	20	0.9462	ALLSOPP (1934)
15	0.95099	„	20	0.9466	RICHARDS and SHIPLEY (1916)
30	0.93761	„			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	2453	B.E. (1937)	17.3	2300	HERZ and BLOCH (1924)
30	1803	„	39.1	1549	„
			65.9	1012	„

Surface tension

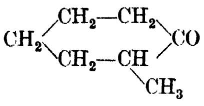
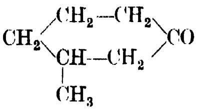
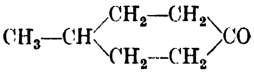
t°	γ	
15	35.12	B.E. (1937)
20	34.50	„
30	33.51	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.44922	1.44956	1.45203	1.45220	1.45696	1.45818	1.46176	B.E. (1937)
$\frac{dn}{dt}$	0.00036	36	—	37	37	38	38	„
19.3	—	—	1.45066	—	—	—	—	HERZ and BLOCH (1924)

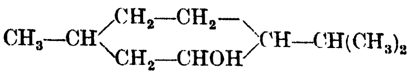
METHYL-*cyclo*-HEXANONES

Constants: CHIURDOGLU (1938)

	2-METHYL 	3-METHYL 	4-METHYL 
Boiling point	165°08	169°58	171°25
Freezing point	−14°	−73°5	−40°6
TIMMERMANS (passim)			
Density: 0°	0.94238	0.93214	0.93241
15°	0.92933	0.91954	0.91984
20°	7.92500	0.91535	0.91562
30°	0.91632	0.90694	0.90728
Viscosity: 15°	1845	1999	1916
$\eta \cdot 10^5$ 30°	1406	1512	1457
Refractive index: 20°			
Hα	1.44571	1.44360	1.44290
He y.	1.44817	1.44606	1.44536
Hβ	1.45392	1.45182	1.45112
Hγ	1.45873	1.45658	1.45588

3-METHYL-*cyclo*-HEXANONE: ***Rotatory dispersion in the ketonic absorption bands:*** LOWRY, SIMPSONS and ALLSOPP (1937)

MENTHOL (*l* and *d*)



$$CH_3{-}CH\left\langle\begin{array}{l}CH_2{-}CH_2{-}\\CH_2{-}CHOH\end{array}\right\rangle CH{-}CH(CH_3)_2$$

Constants

Boiling point: 216°3 Lecat

Melting point

42°45	Hulett (1899)	42°5	Adamanis (1933)
42°5	Wright (1917)	43°	Pickard and Littlebury (1912)

Melting curve

Form I		Form II		
t°	p kg/cm²	t°	p kg/cm²	
42.45	1	36.40	1	Hulett (1899)
43.00	25	36.90	25	,,
43.75	50	37.60	50	,,
44.35	75	38.30	75	,,
44.85	100	38.90	100	,,
45.55	125	39.40	125	,,
46.20	150	40.05	150	,,
46.80	175	40.75	175	,,
47.25	200	41.35	200	,,
47.90	225	41.95	225	,,
48.60	250	42.60	250	,,
49.25	275	43.15	275	,,
49.80	300	43.70	300	,,

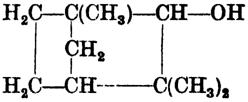
Density

t°	d		t°	d	
40.9	0.8839	Patterson and Taylor	80	0.8534	Kenyon and Pickard
59	0.8699	„ (1905)	100	0.8379	„ (1915)
80	0.8534	„	120	0.8223	„
20	0.9007	Kenyon and Pickard	140	0.8070	„
40	0.8848	„ (1905)	160	0.7917	„
60	0.8690	„	180	0.7760	„

Rotatory power

t°	(α) D		t°	(α) D	
35.2	49.73	Patterson and Taylor	63.2	49.95	Patterson and Taylor
39.5	49.82	„ (1905)	70.2	49.90	„ (1905)
43.0	49.88	„	78.0	49.82	„
48.2	49.89	„	100	49.51	„
53.5	49.94	„	40	49.55	Kenyon and Pickard
58.3	49.96	„			(1915)

FENCHYL ALCOHOL (*l* and *d*)

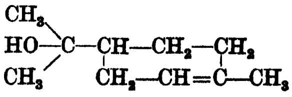


Melting point: 42°1 Fischer (1939)
41°5 Deffet (1940)

Melting curve: Deffet (1940)

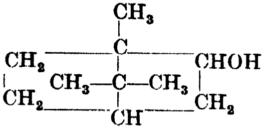
t°	p kg/cm²		t°	p kg/cm²	
41.5	1		60.6	796	
48.0	282		63.6	940	
55.0	584				

TERPINEOL and esters.



Density, refractive index, rotatory power: Fuller and Kenyon (1924).
Boiling point: Terpineol α: 218°85; Terpineol β: 210°5 Lecat.

BORNEOL



Constants: Vanstone (1910–1909)

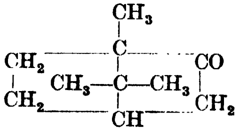
Saturated vapour pressure

Stat. meth.		*Dynam. meth.*	
t°	p mm	t°	p mm
78.0	2.30	77.9	2.16
95.1	6.67	96.8	6.55
110.5	15.70	110.0	15.00
130.2	40.4	131.0	40.92
150.2	96.6	156.6	115.16
158.4	127.2		

Boiling point: 215°0
215°0 Lecat

Melting point: 208°6

CAMPHOR



Constants

Saturated vapour pressure: de Wilde (1937)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
C. 65.14	3.9	105.14	27.3	140.84	108.4	168.24	272.7
69.84	6.1	109.24	31.7	146.54	127.8	168.94	274.2
75.54	8.0	110.34	32.7	150.84	152.3	171.14	295.1
79.94	8.9	115.54	41.6	152.94	165.6	173.44	318.4
85.14	10.5	117.04	42.8	155.84	182.1	173.74	321.1
88.84	14.0	120.54	50.5	157.14	190.0	176.24	346.2
92.94	15.9	125.74	61.6	158.04	196.2	177.64	359.7
95.14	17.0	129.74	71.9	160.94	216.8	178.54	368.1
100.04	21.9	130.94	74.5	163.14	231.6	179.44	379.3
102.54	23.9	136.14	89.8	165.94	252.6	180.34	390.0
103.24	25.7						
L. 178.04	368.1	186.34	456.1	198.74	619.5	215.64	920.3
179.14	379.3	188.54	481.6	201.74	664.8	220.84	1027.9
180.14	390.0	191.54	514.1	203.94	699.2	225.44	1143.4
181.14	398.4	191.64	517.0	206.74	749.1	225.84	1150.4
182.24	408.3	193.54	544.1	211.04	817.8	232.34	1290.8
183.24	419.5	195.74	587.6				

Boiling point

207°42	de Wilde (1937)	209°1	Lecat

Freezing point

178°43	Fransden (1931)	178°8 *(rac)*	Louguinine (1889)
178°5 *(d)*	Fischer (1939)	178°8	Faucon (1912)
178°6 *(d)*	Roos and Somerville (1926)	179°5	de Wilde (1937)
178°6	Haller (1892) (from Bangphiën)		

Triple point: 180°1/385.8 mm. De Wilde (1937)

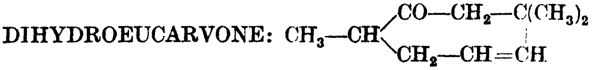
Rotatory power: 15°–16° (α)D: ±42.76 Haller (1892
180°, between 5893 and 2485 Å, see diag. Lowry and Gore (1932)

Heat of melting	10.74 cal 15°/g	Fransden (1931)

METHOXYMETHYLENE CAMPHOR: $C_{12}H_{18}O_2$: *Density* and *refractive index:* Brühl (1894).

PULEGONE: $C_{10}H_{16}O$
Boiling point: 223°8 Lecat; *refractive index, rotatory power:* Lowry, Simpsons and Allsopp (1937).

d-CARVONE: $(CH_3)C_6H_6O\ C(CH_3){=}CH_2$; DIHYDROCARVONE: $(CH_3)C_6H_8OC(CH_3){=}CH_2$;

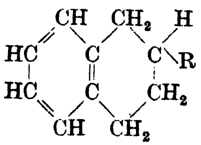


DIHYDROEUCARVONE: $CH_3\text{—}CH\begin{array}{l} \diagup CO\text{—}CH_2\text{—}C(CH_3)_2 \\ \qquad\qquad\qquad\quad | \\ \diagdown CH_2\text{—}CH{=}CH \end{array}$

and CARVENONE: $CH_3\text{—}C_6H_6O\text{—}CH(CH_3)_2$

Boiling point: Lecat; *density, refractive index:* Brühl (1899) and Hernquist (1914).

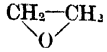
ESTERS of *l*- and *d*-TETRAHYDRO-2-NAPHTHOL: $R{=}CH_3CO_2$; $C_2H_5CO_2$; $C_4H_9CO_2$; *n*-$C_{11}H_{23}CO_2$: Kenyon and Pickard (1912–14).



METHYL-*cyclo*-PROPANE-1,1-DICARBOXYLATES and homologues: $(CH_2)_2.C(CO_2CH_3)_2$: *Density, refractive index, rotatory power:* Vogel (1934).

6. HETEROCYCLIC OXYGEN COMPOUNDS

EPOXYETHANE or ETHYLENE OXIDE



Constants: B.E. (1937)

Satured vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−49.372	33.94	−21.847	175.58	+0.194	497.41	Giauque and Gordon
−43.311	50.70	−16.956	225.28	5.644	625.07	„ (1949)
−38.242	69.68	−14.825	250.14	9.210	721.95	„
−33.273	93.73	− 9.828	317.68	11.934	804.01	„
−28.169	124.93	− 4.904	397.77			„

Boiling point

10°50		Giauque and Gordon (1949)
10°7	$\frac{dt}{dp}$	*(10 mm):* 0°40 B.E. (1937)
10°75		Lecat

Freezing point

−111°7	B.E. (1937)
−112°51	Giauque and Gordon (1949)

Density: (with dilatometer) 0° 0.89713 5° 0.89057

Viscosity

t°	$\eta \cdot 10^5$	
0	309	B.E. (1937)
5	295	„
10	283	„

Surface tension

t°	γ	
0.1	28.00	B.E. (1937)
4.9	27.24	„
10	26.39	„

Specific heat: Giauque and Gordon (1949) (M.W. 44.052)

t°	c_p	t°	c_p	t°	c_p	
−257.83	0.015	−164.74	0.271	−76.37	0.440	(other temperatures, see authors)
−247.71	0.0549	−151.66	0.292	−64.31	0.443	
−237.03	0.101	−132.52	0.331	−52.49	0.444	
−224.33	0.149	−126.97	0.348	−39.96	0.447	
−214.92	0.179	−121.76	0.365	−32.59	0.450	
−205.45	0.204	L. −107.19	0.447	−19.67	0.455	
−195.03	0.224	−101.14	0.445	− 7.55	0.461	
−183.69	0.243	− 89.45	0.444	+ 2.52	0.467	
				10.77	0.470	

Heat of vaporisation:	138.5	cal 15°/g	Giauque and Gordon (1949)
Heat of melting:	28.066	„	„

PARALDEHYDE $(CH_3\,CHO)_3$

This compound is purified by crystallization. For the equilibria with acetaldehyde and the "natural constants" of this system of dynamic isomers, see: HOLLMANN (1903).

Constants

Critical temperature: 290° HOLLMANN (1903)

Boiling point

123°87	HOLLMANN (1903)
123°93	COFFETTI (1903)
124°35	LECAT and FRIEND and HARGREAVES (1944)

Melting point

12°5	COOPER (1926–27)
12°55	HOLLMANN (1903)
12°6	LOUGUININE and DUPONT (1911)
12°61	TURBABA (1901)

Density

t°	d		t°	d	
12	1.00058	PASCAL and DUPUY (1920)	60.1	0.9454	FRIEND and HARGREAVES
20	0.9933	„	70.0	0.9342	„ (1944)
40	0.9673	„	79.2	0.9233	„
15.0	0.9962	FRIEND and HARGREAVES	91.2	0.9088	„
42.6	0.9654	„ (1944)			
51.3	0.9558	„			

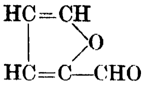
Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
10	1527	DRUCKER and KASSEL	60.1	595.7	FRIEND and HARGREAVES
76.5	478	„ (1911)	70.0	520.6	„ (1944)
20	1178	MUCHIN (1913)	79.2	464.2	„
15.0	1324	FRIEND and HARGREAVES	91.2	401.8	„
42.6	775	„ (1944)	103.9	349.5	„
51.3	674.7	„	117.2	302.7	„

Surface tension: 5° 27.82 SCHIFF (1884)

Magnetic rotatory power	17°3 0.9058	PERKIN (1884)

FURFURAL



Constants

Saturated vapour pressure: EVANS and AYLESWORTH (1926)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
39.9	8	131.6	310	159.0	707	163.8	812
92.3	69	140.2	411	160.9	744	170.6	966
120.3	214	154.4	625				

Boiling point

161°45	LECAT	161°7	EVANS and AYLESWORTH (1926)
161°7	MAINS (1922)	161°9	VON REIS (1881)

Critical solution point in H_2O: 120°9 EVANS and AYLESWORTH (1926)

Density

t°	d		t°	d	
0	1.1808	WALDEN (1906)	20	1.1598	MAINS (1922)
25	1.1544	„	25	1.1545	„
0	1.1811	WALDEN (1908–09)	25	1.1546	WALDEN (1907)
25	1.1544	„			
50	1.1284	„			

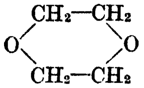
Viscosity

t°	$\eta \cdot 10^5$	
0	2475	WALDEN (1906)
25	1494	„

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.51862	1.52608	1.54566	1.56484	BRÜHL (1886)
20	—	1.52608	—	—	EVANS and AYLESWORTH (1926)
25	—	1.52345	—	—	WALDEN (1907)

DIOXAN



It is impossible to purify dioxan by simple fractional distillation: this operation must be alternated with fractional fusion. In addition an isomerisation to acetal takes place: this transformation leads to an equilibrium system, containing 3 % of acetal, melting at 10°2. Furthermore, an enantiotropic modification exists, having a transition point of −0°1 (Deffet, 1935).

Røsendahl (1946) studied the critical constants, the saturated vapour pressure, the viscosity and the surface tension; he does not entirely agree with us, although his melting point is 11°75–11°80.

Constants: B.E. (1937).

Boiling point

101°320	$\frac{dt}{dp}$ *(10 mm)*:	0°432	Wojciechowski and Smith (1937)
101°35	,,	0°43	Lecat
101°40	,,	0°43	B.E. (1937)
101°43			Teague and Felsing (1943)
101°50			Pesce and Lago (1944)

Melting point

11°65	Pesce and Lago (1944)	11°8	Teague and Felsing (1943)
11°7	Schütz (1938)	11°80	B.E. (1937)
11°76	Harned and Morrison (1936)	11°80	Ewert (1937)
11°78	Røsendahl (1946)	11°80	Hess and Frahm (1938)

Density

t°	d		t°	d	
15	1.03922	B.E. (1937)	25	1.0276	Schneider and Lynch (1943)
20	1.03361	,,			
30	1.02230	,,	25	1.0280	Teague and Felsing (1943)
20	1.03364	Schütz (1938)			
20	1.03375	Hess and Frahm (1938)	25	1.02802	Pesce and Lago (1944)

Viscosity

t°	$\eta \cdot 10^5$	
15	1439	B.E. (1937)
30	1087	„

Surface tension

t°	γ	
15	34.45	B.E. (1937)
20	33.74	„
30	32.20	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.42198	1.42225	1.42436	1.42456	1.42865	1.42958	1.43290	—	B.E. (1937)
$\frac{dn}{dt}$	0.00042	42	—	43	43	43	44	—	„
20	—	—	1.42241	—	—	—	—	—	Hess and Frahm (1938)
25	—	—	1.4201	—	—	—	—	—	Schneider and Lynch (1943)
25	—	—	1.4202	—	—	—	—	—	Teague and Felsing (1943)
25	—	—	1.4202	—	—	—	—	—	Few and Smith (1949
25	—	—	1.42025	—	—	—	—	—	Frey and Gilbert (1937)

MALEIC ANHYDRIDE $(CHCO)_2O$

Constants

Saturated vapour pressure: Winstrom and Kulp (1949)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
35.0	0.36	50.0	1.90	52.8	2.24	60.0	3.39
40.0	0.69	51.0	1.99	54.0	2.34	65.0	4.43
45.0	1.22	52.0	2.16	55.0	2.53	70.0	5.93

Boiling point:	200° Perkin (1888)
Melting point:	52°6 Weiss and Downs (1923)
	52°8 Winstrom and Kulp (1949)

7. SUGARS

α-*d*-GALACTOSE $C_6H_{12}O_6$

Rotatory power: $(\alpha)^{20^\circ}_{D}$: 80°0 (Final) Jack and Stegeman (1941)

Specific heat: Jack and Stegeman (1941) (M.W. 180.156)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
−209.24	0.06284	−140.00	0.1357	−78.08	0.1941	−9.28	0.2584
−199.13	0.07450	−130.76	0.1448	−68.34	0.2027	−0.62	0.2687
−179.30	0.09670	−120.75	0.1541	−59.38	0.2115	+7.21	0.2744
−169.68	0.1066	−111.83	0.1619	−38.45	0.2287	15.12	0.2790
−159.98	0.1165	−103.71	0.1695	−29.47	0.2370	23.70	0.2926
−149.08	0.1265	− 87.39	0.1827	−17.38	0.2483		

l-SORBOSE $C_6H_{12}O_6$

Rotatory power: $(\alpha)^{20^\circ}_{D}$ −43°1 (Final) Clarke and Stegeman (1939)

Specific heat: Jack and Stegeman (1941) (M.W. 180.156)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
−209.14	0.06372	−131.87	0.1520	−70.89	0.2191	−15.69	0.2655
−190.77	0.08487	−121.57	0.1636	−59.20	0.2237	− 5.12	0.2764
−168.12	0.1096	−113.06	0.1735	−48.72	0.2351	+10.86	0.2893
−148.99	0.1304	−102.21	0.1891	−37.98	0.2440	19.69	0.2984
−140.80	0.1403	− 90.46	0.2075	−27.48	0.2527		

SACCHAROSE $C_{12}H_{22}O_{11}$

Purified by crystallization from absolute alcohol *in vacuo* (Dickinson, 1915 and Vosburgh, 1921). For criteria of purity, see: "*Publications of the Institute of pure Reagents of Moscow*".

Heat of combustion	20°, (c_v) 3943 cal 15°/g	Karrer and Fioroni (1923)
	15°–20°, (c_v) 3943 „	Swietoslawski and Starczewska (1922)
	20°, (c_v) 3943 „	Dickinson (1915)

α-LACTOSE MONOHYDRATE $C_{12}H_{22}O_{11}.H_2O$

Rotatory power: $(\alpha)_{D}^{20^\circ}$ 55.°0 (Final) CLARKE and STEGEMAN (1939)

Specific heat: ANDERSON and STEGEMAN (1941) (M.W. 360.314)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
−208.01	0.06558	−132.31	0.1447	−60.75	0.2115	−11.44	0.2589
−198.16	0.07690	−109.12	0.1663	−50.77	0.2218	+ 1.17	0.2696
−191.42	0.08429	− 92.55	0.1817	−41.47	0.2294	11.05	0.2796
−181.43	0.09613	− 77.77	0.1960	−34.04	0.2372	20.19	0.2889
−169.42	0.1072	− 69.01	0.2045	−20.24	0.2516	24.26	0.2916
−150.93	0.1265						

β-LACTOSE $C_{12}H_{22}O_{11}$

Rotatory power: $(\alpha)_{D}^{20^\circ}$ 55°0 (Final) CLARKE and STEGEMAN (1939)

Specific heat: ANDERSON and STEGEMAN (1941) (M.W. 342.298)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
−200.27	0.07312	−134.34	0.1394	−71.92	0.1970	−10.40	0.2540
−185.32	0.08933	−123.84	0.1486	−55.54	0.2151	− 2.23	0.2618
−168.65	0.1058	−108.30	0.1644	−37.87	0.2297	+ 7.05	0.2714
−158.84	0.1156	− 90.11	0.1789	−20.30	0.2469	16.28	0.2791
−143.18	0.1303	− 82.69	0.1860				

β-MALTOSE MONOHYDRATE $C_{12}H_{22}O_{11}.H_2O$

Rotatory power: $(\alpha)_{D}^{20^\circ}$ 131°0 (Final) CLARKE and STEGEMAN (1939)

Specific heat: ANDERSON and STEGEMAN (1941) (M.W. 360.314)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
−212.05	0.06086	−151.49	0.1285	−79.08	0.1968	−30.96	0.2451
−202.76	0.07116	−140.16	0.1387	−71.17	0.2054	−14.02	0.2637
−191.03	0.08566	−125.23	0.1549	−61.47	0.2163	− 1.13	0.2744
−181.93	0.09608	−108.21	0.1714	−49.72	0.2279	10.42	0.2852
−169.69	0.1094	−100.11	0.1785	−37.91	0.2399	23.11	0.2990
−159.80	0.1189	− 89.68	0.1886				

8. MIXED OXYHALOGENATED DERIVATIVES

CARBONYL CHLORIDE or PHOSGENE $COCl_2$

Constants: GIAUQUE and JONES (1948)

Boiling point: 7°56

Melting point: −127°86

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm
−57.619	24.75	−32.132	122.12	−0.953	541.28
−51.651	37.32	−25.527	173.88	+3.948	660.07
−45.783	54.67	−17.778	255.50	8.003	773.12
−39.357	80.75	− 9.087	381.88		

Density: DAVIES (1946)

t°	d	t°	d	t°	d
0.00	1.4187	14.50	1.3853	27.00	1.3547
5.00	1.4076	20.00	1.3714	37.00	1.3310

$dt = 1.42014 - 0.0023120\, t^\circ - 0.000002872\, t^{\circ 2}$ DAVIES (1946)

Specific heat

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −258.30	0.0164	−202.59	0.1139	L. −124.78	0.2526	−61.24	0.2403
−257.12	0.0197	−196.06	0.1187	−120.42	0.2508	−55.36	0.2403
−255.34	0.0272	−190.19	0.1225	−115.65	0.2491	−49.00	0.2404
−252.67	0.0363	−184.04	0.1262	−110.10	0.2472	−36.20	0.2412
−249.11	0.0463	−177.36	0.1306	−103.76	0.2459	−22.99	0.2420
−244.82	0.0569	−171.20	0.1341	− 97.36	0.2447	−10.34	0.2426
−240.16	0.0681	−164.62	0.1383	− 91.09	0.2441	+6.30	0.2429
−235.09	0.0781	−158.21	0.1428	− 84.90	0.2425		
−229.80	0.0856	−151.67	0.1458	− 78.21	0.2414		
−224.62	0.0924	−146.19	0.1499	− 72.16	0.2405		
−219.35	0.0990	−140.19	0.1517	− 66.00	0.2400		
−214.51	0.1037	−136.45	0.1556				
−209.12	0.1084	−132.42	0.1606				

Heat of vaporisation	(B.P) 58.96 cal 15°/g	
Heat of melting	13.86 „	

ETHYLENE CHLOROHYDRIN $CH_2Cl.CH_2OH$

(2-CHLOROETHYL ALCOHOL)

This compound gives with water an azeotrope, boiling at 97°8, with 45.8 % of chlorohydrin according to PALHAVOUNI (1927); 42.5 % according to GOMBERG (1919), or 41 % according to BANCELIN and RIVAT (1919).

Constants: B.E. (1928)

Boiling point: 128°6 $\frac{dt}{dp}$ *(10 mm):* 0°40 B.E. (1928) and LECAT

Freezing point: −67°5

Density

t°	d		t°	d	
0	1.22310	B.E. (1928)	20	1.2022	MATHEWS (1926)
15	1.20720	”			
20	1.20190	”			
30	1.19118	”			

Viscosity

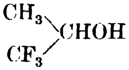
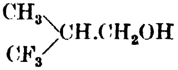
t°	$\eta \cdot 10^5$	
15	3913	B.E. (1928)
30	2688	”

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.44148	1.44380	1.44946	1.45414	B.E. (1928)
$\frac{dn}{dt}$	0.00039	39	38	37	”
20	—	1.44208	—	—	MATHEWS (1926)

Heat of vaporisation	(126°55) 122.97 cal 15°/g	MATHEWS (1926)

	2-FLUOROETHYL ALCOHOL $CH_2F.CH_2OH$				2,2-DIFLUOROETHYL ALCOHOL $CHF_2.CH_2OH$			
Constants: SWARTS (1923–27–31)								
Density	18°3	1.1143			17°2	1.3084		
Viscosity: $\eta \cdot 10^5$	20°	1924	50°	1044	20°	2650	50°	1275
	30°	1540	60°	889	30°	2030	60°	1042
	40°	1247			40°	1580		
Refractive index								
Hα	18°3	1.3622			17°2	1.33290		
Hβ		1.3684				1.33729		
Hγ		1.3714				1.34148		

	TRIFLUOROALKYL ALCOHOLS						
	$CF_3.CH_2OH$		 $(CH_3)(CF_3)CHOH$		 $(CH_3)(CF_3)CH.CH_2OH$		
Constants: SWARTS (1927–29–31–34)							
Boiling point	74°05		77°95		81°60		
Melting point	−43°5		—		20°75		
Density	0°	1.4106	15°	1.2799	22°6	1.1903	
	22°	1.3736					
Viscosity: $\eta \cdot 10^5$	20°	1995	15°	3685	25°	3328	3320
	30°	1543	24°92	2586	30°	2706	2706
	40°	1216	35°	1772	35°	2240	2240
	60°	796	44°95	1301	40°	1836	1845
			55°	994	45°	1591	1590
					SWARTS	(1927)	(1931)
Refractive index							
Hα	22°	1.2896	15°	1.31610	22°6	1.33120	
D		1.2907		1.31720		1.33241	
Hβ		1.2934		1.32120		1.33619	
Hγ		—		1.32253		1.33804	

DICHLOROETHYL ETHER: $(C_2H_4Cl)_2O$: *Boiling* and *melting point, density:* TSCHAMLER (1948).

DIFLUOROACETIC ACID
$CHF_2.CO_2H$

Constants: Swarts (1919-23-31)

Boiling point: 134°2

Melting point: 40°35

Density: 20°1 1.52546

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$
20	2982	50	1550
30	2332	60	1296
40	1904		

Refractive index 20°

20°	Hα	1.34044
	D	1.34195
	Hβ	1.34553
	Hγ	1.34812

TRIFLUOROACETIC ACID
$CF_3.CO_2H$

Constants: Swarts (1922-31)

72°4-72°5

−15°25

0° 1.53515

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$
19.75	876	50.35	569
30.05	750	60.4	502
39.92	653	65.42	473

MONOCHLOROACETIC ACID $CH_2Cl.CO_2H$

Constants

Boiling point: 189°35 Lecat

Melting point

α 62°3	Grinakowski (1913)	β 56°3	Michel (1938)
„ 62°45	Hulett (1899)	γ 50°65	„
„ 62°80	Michel (1938)		
„ 63°	Rabinowitsch (1926)		
„ 63°	Sudborough and Lloyd (1899)		

Melting curve: Hulett (1899)

	t°	atm.	t°	atm.	t°	atm.	t°	atm.
Form α	62.45	1	64.40	100	65.85	175	67.10	250
	62.90	25	64.90	125	66.30	200	67.60	275
	63.40	50	65.40	150	66.70	225	68.10	300
	63.90	75						

Density · *Surface tension*

t°	d	t°	d	t°	γ	
39.75	1.4043	60°80	1.3734	48.8	33.74	GRINAKOWSKI (1913)
49.30	1.3884	79°30	1.3518	58.8	32.66	,,
				70.10	31.56	,,

MONOBROMO and MONOIODO ACETIC ACIDS: $CH_2Br.CO_2H$ and $CH_2I.CO_2H$: *Melting point, density* and *surface tension:* JASPER and ROSENSTEIN (1942).

β-CHLOROCROTONIC ACID β-CHLORO *iso*-CROTONIC ACID

$CH_3.CCl.CH.CO_2H$

Constants: SKAU and SAXTON (1928)

Melting point 93°6 60°5

Specific heat	C. (93°6) 0.327 L. ,, 0.413	C. (60°5) 0.303 L. ,, 0.395	
Heat of melting	41.080 cal 15°/g	27.387 cal 15°/g	

ACETYL and *n*-PROPIONYL CHLORIDES: CH_3COCl and C_2H_5COCl: *Boiling point, density* and *viscosity:* FRIEND and HARGREAVES (1946).

n-CAPROYL CHLORIDE *n*-$C_5H_{11}.COCl$

Constants: SIMON (1929)

Boiling point: 152°60 *Freezing point:* −87°3

Density

t°	d
0	0.99541
15	0.98047
30	0.96540

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ
15	1.42593	1.42615	1.42859	1.42877	1.43341	1.43467	1.43824	1.43981
25	1.42148	1.42181	1.42424	1.42435	1.42896	1.43024	1.43377	1.43505
$\frac{dt}{dn}$	0.00044	44	43	44	44	44	45	47

	ACID-CHLORIDES						
	n-OENANTHOYL $C_6H_{13}COCl$		*n*-CAPRYLOYL $C_7H_{15}COCl$		*n*-PELARGOYL $C_8H_{17}COCl$		*n*-CAPRINOYL $C_9H_{19}COCl$
Constants: DEFFET (1931)							
Boiling point	175°2		195°55		215°35		232°3
Freezing point	−83°8		−61°0		−60°5		−34°5
Density: 0°	0.98079		0.96707		0.95901		—
15°	0.96645		0.95349		0.94633		—
30°	0.95219		0.94000		0.93353		—
Viscosity: $\eta \cdot 10^5$							
15°	1210		1564		1913		—
30°	977		1216		1447		—
Refractive index: 15°		$\frac{dn}{dt} \cdot 10^5$		$\frac{dn}{dt} \cdot 10^5$		$\frac{dn}{dt} \cdot 10^5$	
He r.	1.43032	44	1.43344	43	1.43766	38	—
Hα	1.43077	44	1.43408	42	1.43802	38	—
He y.	1.43329	44	1.43648	43	1.44054	39	—
He g.	1.43794	44	1.44127	42	1.44530	38	—
Hβ	1.43907	44	1.44245	42	1.44647	38	—
He v.	1.44236	44	1.44583	43	1.44977	39	—
Hγ	1.44372	44	1.44730	—	1.45111	39	—

SUCCINOYL CHLORIDE $COCl.CH_2.CH_2.COCl$

Constants: FRIEND and HARGREAVES (1946)

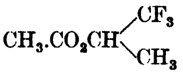
Melting point: 16°7

Density and viscosity

t°	d	$\eta \cdot 10^3$	t°	d	$\eta \cdot 10^3$
20.3	1.3771	25.27	100.8	1.2783	7.656
41.55	1.3507	16.75	119.2	1.2552	6.313
52.0	1.3375	14.23	139.1	1.2300	5.224
61.65	1.3257	12.45	159.7	1.2035	4.365
71.6	1.3141	10.89	170.0	1.1900	4.018
82.8	1.3002	9.45			

	FLUOROETHYL ACETATES		
	MONO $CH_3.CO_2.CH_2.CH_2{\cdot}F$	DI $CH_3.CO_2.CH_2.CHF_2$	TRI $CH_3.CO_2.CH_2.CF_3$
Constants: SWARTS (1919-23-31-34)			
Boiling point	119°55	106°4	77°8
Density	20° 1.0982 20°2 1.0982	13° 1.1958 15° 1.1781	20° 1.2426
Viscosity: $\eta \cdot 10^5$			
20°	1086	1130	698
30°	927	953	604.9
40°	796	816	528.4
50°	697	(49°9) 703	465.3
60°	618	613	—
Refractive index: 15°			
Hα	1.37545	1.35294	1.31884
D	1.37792	—	1.32020
Hβ	1.38212	1.35847	1.3233
Hγ	1.38533	1.36154	—

TRIFLUORO-*iso*-PROPYL ACETATE



$CH_3.CO_2CH\langle^{CF_3}_{CH_3}$

Constants: SWARTS (1929–31)

Boiling point: 85°6/75 mm

Density: 15° 1.1823

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
19.85	725.5		50.15	478	
30.05	623.2		60	425.4	
39.95	544.7				

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.33021	1.3314	1.33520	1.33806	

	ETHYL FLUOROACETATES		
	MONO $CH_2F.CO_2C_2H_5$	DI $CHF_2.CO_2C_2H_5$	TRI $CF_3.CO_2C_2H_5$
Constants: SWARTS (1919–23–31–34)			
Boiling point	121°7	99°4	—
Density	20°5 1.0926	9°8 1.18933 17° 1.1800	16°7 1.19529
Viscosity: $\eta \cdot 10^5$			
20°	958.0	761.2	434.2
30°	817.6	661.6	384.8
40°	707.8	580.5	344.9
50°	619.1	515.7	312
60°	553	459.7	(60°15) 282
Refractive index	20°5	9°8	16°7
Hα	1.37494	1.34888	1.30783
D	1.37665	—	—
Hβ	1.38075	1.35324	1.31237
Hγ	1.38413	—	1.31527

TRIFLUOROETHYL TRIFLUOROACETATE $CF_3.CO_2CH_2CF_3$

Constants: SWARTS (1923–31–34)

Boiling point: 55° *Freezing point:* −65°

Density		*Viscosity*		*Refractive index*			
t°	d	t°	$\eta \cdot 10^5$	t°	Hα	D	Hg (546)
0	1.5179	20	672	18	1.2799	1.2812	1.2823
18	1.4725	30	580.6				
40	1.4174	40	506.7				

ETHYL MONO, DI and TRICHLOROACETATES: CH_2Cl; $CHCl_2$; $CCl_3CO_2C_2H_5$: *Boiling point:* LECAT (passim); *density* and *surface tension:* DESREUX (1935): *density:* KREMANN, MEINGAST and GUGL (1914) and *heat of combustion:* SCHJÄNBERG (1934–35).

d-*β*-OCTYL CHLOROACETATE, BROMOACETATE and IODOACETATE: $CH_2Cl.CO_2C_8H_{17}$, $CH_2Br.CO_2C_8H_{17}$ and $CH_2I.CO_2C_8H_{17}$: RULE and MITCHELL (1926).

ETHYL TRICHLOROBUTYRATE, BROMOACETATE, BROMOPROPIONATE, BROMOBUTYRATE and BROMO-*iso*-BUTYRATE: $CCl_3.CH_2.CH_2.CO_2C_2H_5$, $CH_2Br.CO_2C_2H_5$, $CH_2Br.CH_2.CO_2C_2H_5$, $CH_2Br.CH_2.CH_2.CO_2C_2H_5$ and $(CH_3)_2CBr.CO_2C_2H_5$: *Boiling point, density refractive index, magnetic rotatory power:* Perkin (1894).

ETHYL BROMODI-*n*-PROPYLACETATE: $CBr(n\text{-}C_3H_7)_2.CO_2C_2H_5$: *Boiling point, density, refractive index:* Eykman (1919).

METHYL and ETHYL BROMOPROPIONATES: $CH_2Br.CH_2.CO_2CH_3$ and $CH_2Br.CH_2.CO_2C_2H_5$: *Boiling point, density, rotatory power:* Walker (1909).

ETHYL DICHLOROSUCCINATE: $C_2H_5CO_2.(CHCl)_2.CO_2C_2H_5$: *Boiling point, density, rotatory power:* Wood and Nicholas (1928).

FLUOROPHENOLS $C_6H_4F.OH$

	Ortho	*Meta*	*Para*
Constants			
Boiling point:	151°	177°8	185°6
	Swarts (1912)	Swarts (1919)	Swarts (1919)
Freezing point:			
	16°1 Swarts (1913–19)	13°5 Swarts (1919)	48°2 (st.) Swarts (1919)
	16°1 Schiemann (1931)	13°7 Schiemann (1931)	28°5 (unst.) „
	—	13°8 Swarts (1913)	—
Density:	—	15°2 1.22176 Swarts (1923)	—
	15°8 1.2172 Schiemann (1931)	20° 1.2133 Schiemann (1931)	—
Refractive index:			—
	—	15°2	—
Hα	—	1.51218	—
D	—	1.51650	—
Hβ	—	1.52903	—
Hγ	—	1.53991	—
		Swarts (1923)	—

FLUOROPHENETOLES $C_6H_4F{\cdot}OC_2H_5$

	Ortho	*Meta*	*Para*	
Constants				
Boiling point	—	171°6	172°5	Swarts (1913–19)
Melting point	−16°7	—	−8°5	„
Density	13°4 1.08715	16°7 1.0720	18°2 1.07148	„ (1919–23)

FLUOROPHENETOLES $C_6H_4F{\cdot}OC_2H_5$ (continued)

	Ortho		*Meta*		*Para*		
Viscosity: $\eta \cdot 10^5$	20°05	1520	20°	1314	20°15	1340	Swarts (1931)
	30°	1250	30°1	1090	30°	1113	„
	40°	1057	40°03	930	40°	950	„
	49°95	917	44°95	860	50°	820	„
			50°	804	60°	715	„
			60°	703			„
Refractive index							
Hα	13°4	1.48922	16°7	1.4805	18°2	1.4787	Swarts (1923)
D		1.49332		1.48491		1.48257	„
Hβ		1.50410		1.49602		1.49329	„
Hγ		1.51360		1.50500		1.50242	„

CHLOROACETOPHENONE: $C_6H_5.CO.CH_2Cl$: *Saturated vapour pressure:* Balson(1947)
MONOCHLOROQUINONE: $C_6H_3ClO_2$; MONOCHLOROQUINOL: $C_6H_3Cl(OH)_2$;
2,6-DICHLOROQUINONE: $C_6H_2Cl_2O_2$; 2,6-DICHLOROQUINOL: $C_6H_2Cl_2(OH)_2$;
TRICHLOROQUINONE: $C_6HCl_3O_2$; TRICHLOROQUINOL: $C_6HCl_3(OH)_2$;
TETRACHLOROQUINONE: $C_6Cl_4O_2$; TETRACHLOROQUINOL: $C_6Cl_4(OH)_2$;
Sublimation pressure: Coolidge and Coolidge (1927).

CHLOROBENZOIC ACIDS $C_6H_4Cl.CO_2H$

Constants

	Ortho	*Meta*	*Para*	
Melting point	140°2	154°25	239°7	Andrews, Lynn and Johnston (1926)
	139°5	156°	240°0	Flaschner and Rankin (1910)
	—	155°	—	Hope and Riley (1922)
Specific heat	L. 140°2 0.442	L. 154°25 0.414	L. 239°7 0.547	Andrews, Lynn and Johnston (1926)
	C. „ 0.346	C. „ 0.344	C. „ 0.375	
	C. 25° 0.249	C. 25° 0.250	C. 25° 0.256	„
Heat of melting cal 15°/g	39.27	36.39	49.23	„

d-OCTYL CHLORO, BROMO, IODOBENZOATES: $C_6H_4R.CO_2C_8H_{17}$ (R=Cl, Br, I)

Boiling point, density and *rotatory power:* Rule, Hay, Numbers and Patterson (1928).

HALOGENATED METHYL BENZOYLTARTRATES: $(RC_6H_4.CO_2CH.CO_2CH_3)_2$ (R=Cl,Br, I)

Melting point, density and *rotatory power:* Frankland, Carter and Adams (1912).

ETHYL, *n*-PROPYL and *n*-BUTYL PHENYLCHLOROACETATES: $C_6H_5.HCl.CO_2R$ (R= C_2H_5, *n*-C_3H_7 and *n*-C_4H_9)

Boiling point, density and *rotatory power:* Walker (1909).

BENZOYL CHLORIDE C_6H_5COCl

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
85.4	17.6	94.1	26.3	101.2	35.7	Kahlbaum (1898)
86.4	18.5	96.2	28.3	102.1	37.2	,,
87.8	19.5	96.4	29.0	103.1	38.6	,,
88.6	20.4	97.2	30.1	104.0	40.2	,,
90.5	21.2	98.5	31.9	104.6	41.2	,,
90.7	22.4	99.5	33.3	105.5	42.8	,,
92.3	24.3	100.6	34.9			,,
79	13	82.5	15.5	92.5	25	Hope and Riley (1922)

Boiling point

196°7	Hope and Riley (1922)	197°	Matsuno and Han (1933)
		197°9	Kamerlingh and Smyth (1933)

Melting point

−0°6	Kamerlingh and Smyth (1933)

Density

15°	1.2188	Lumsden (1905)	15°	1.2187	Matsuno and Han (1933)

Refractive index

$n_D^{15°}$	1.55799	Lumsden (1905)	$n_D^{20°}$	1.55354	Kamerlingh and Smyth (1933)
$n_D^{15°}$	1.5579	Matsuno and Han (1933)			

Ortho, Meta and *Para*-CHLOROBENZOYL CHLORIDES: $C_6H_4Cl.COCl$.

Saturated vapour pressure and *boiling point:* Hope and Riley (1922).

9. NITROGEN DERIVATIVES of the ALIPHATIC SERIES

A. AMINES

These compounds are very sensitive to small amounts of water and carbon dioxide.

METHYLAMINE CH_3NH_2

Constants. — Polyphasic equilibria

Critical constants

t° cr.	p cr. atm.	
156.9	73.6	Berthoud (1917)

Saturated vapour pressure

The values of Berthoud (1917), Felsing and Thomas (1929) and Hsia (1931) do not agree.

t°	p mm	t°	p mm	
−83.162	4.06	−28.758	247.20	Aston, Siller and Messerly (1937)
−74.256	9.59	−23.625	326.65	„
−63.228	19.19	−17.562	446.09	„
−58.895	34.75	−17.232	453.40	„
−51.184	60.67	−12.558	569.33	„
—44.676	94.29	−10.695	621.74	„
−37.111	151.85	− 8.369	693.03	„
−36.700	155.86	− 6.286	761.55	„
−33.401	189.68	− 5.948	773.25	„
−29.636	235.42			„

Isotherms: Kenner and Felsing (1939)

Boiling point

−7°5–7°6/719 mm	Berthoud (1917)	−6°45	Hsia (1931)
−6°79	Felsing and Thomas (1929)	−6°32	Aston, Siller and Messerly (1937)
−6°7	Gibbs (1905)		

Freezing point

−92°5	Timmermans	−93°469	Aston, Siller ans Messerly (1937)
−93°4	Mac Neight and Smith (1936)		

Constants of state

Density: Felsing and Thomas (1929)

t°	d	t°	d	t°	d	t°	d
−82.58	0.77787	−44.31	0.73719	−11.00	0.6992	10.99	0.67335
−73.19	0.76903	−36.37	0.72884	−10.80	0.699	17.21	0.66575
−64.25	0.75850	−20.94	0.71124	− 6.30	0.69423	19.79	0.66277
−55.52	0.74931	−13.60	0.70273	+ 1.86	0.68447		

Surface tension

t°	γ	
15	20.60	Swift Jr. and Calkins
25	19.19	„ (1943)
35	17.65	„

Heat constants

Specific heat: Aston, Siller and Messerly (1937) (M.W. 31.057)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −260.45	0.01002	−210.32	0.2030	−161.60	0.3503	− 96.25	0.5319
−258.40	0.01401	−206.23	0.2213	−156.15	0.3600	L. − 84.81	0.7680
−255.91	0.02193	−202.05	0.2342	−150.68	0.3684	− 78.89	0.7657
−251.97	0.03846	−197.52	0.2478	−145.65	0.3777	− 72.26	0.7683
−250.11	0.04564	−192.77	0.2616	−140.26	0.3867	− 66.52	0.7702
−248.15	0.05427	−188.46	0.2770	−135.76	0.3139	− 60.69	0.7751
−246.41	0.05943	−184.04	0.2901	−128.95	0.3999	− 54.44	0.7780
−244.46	0.06909	−183.39	0.3021	−123.60	0.4115	− 48.88	0.7754
−240.69	0.08716	−181.94	0.3069	−117.37	0.4202	− 42.32	0.7776
−233.33	0.1014	−179.27	0.3120	−117.34	0.4251	− 36.07	0.7799
−228.54	0.1233	−176.91	0.3202	−111.57	0.4312	− 30.55	0.7851
−224.11	0.1468	−173.61	0.3275	−105.96	0.4408	− 24.53	0.7854
−219.44	0.1673	−170.46	0.3339	−100.94	0.4553	− 18.43	0.7851
−214.61	0.1854	−167.58	0.3397	− 98.40	0.4704	− 13.88	0.7835

Heat of vaporisation	(B.P.) 198.6 cal 15°/g	Aston, Siller and Messerly (1937)
Heat of melting	47.197 „	„

ETHYLAMINE $C_2H_5NH_2$

Constants

Critical constants

t° cr.	p cr. atm.	
183.2	55.54	BERTHOUD (1917)

Densities of the liquid and the saturated vapour

t°	V.	t°	L.	V.	
29.2	0.00309	134.9	—	0.0459	POHLAND and MEHL (1933)
35.3	0.00377	138.3	0.5007	—	„
80.4	0.0118	147.2	0.4816	—	„
92.0	0.0172	170.9	—	0.1072	„
99.6	0.0211	178.1	—	0.1393	„
125.4	0.0373	183.4	—	0.2434	„
130.5	0.0420				„

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
15.45	723.52	110.2	11658.4	171.2	35066.4	BERTHOUD (1917)
46.0	2090.0	130.6	17434.4	178.1	39109.6	„
73.6	4810.8	144.8	22480.8	183.2	42210.4	„
93.8	8071.2	162.2	30286			„
−61.29	7.4	−17.81	147.8	5.76	481.3	POHLAND and MEHL (1933)
−53.84	13.8	−13.95	183.0	10.64	594.8	„
−45.23	26.3	− 9.25	234.9	16.24	750.5	„
−34.27	55.6	− 5.65	281.8	21.62	928.8	„
−29.79	74.3	0.0	369.9	23.81	1011.8	„
−22.89	111.2	0.27	374.4			„

Boiling point *Freezing point*

16°45	BERTHOUD (1917)	−80°5	TIMMERMANS
16°5	POHLAND and MEHL (1933)	−81°	POHLAND and MEHL (1933)
16°55	$\frac{dt}{dp}$ *(10 mm) :* 0°28 TIMMERMANS (1910—12) and LECAT (passim)		

Density

t°	d	t°	d	t°	d	
−72.65	0.7854	−38.12	0.7489	0.0	0.7059	Pohland and Mehl (1933)
−59.04	0.7705	−23.81	0.7330	10.10	0.6949	„
−49.55	0.7610	−10.76	0.7186	19.40	0.6837	„
0	0.70566	15	0.68858	25	0.67687	Swift Jr. (1942)
35	0.66482	—	—	—	—	„
0	0.70570	—	—	—	—	Timmermans (1910–12)

Surface tension

t°	γ	
15	20.56	Swift Jr. and Calkins (1943)
25	19.21	„
35	17.82	„

DIMETHYLAMINE $(CH_3)_2NH$

Constants: Aston, Eidinoff and Forster (1939)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm
−71.773	4.86	−23.530	172.13	+2.774	636.50
−59.358	14.69	−16.711	249.54	4.520	686.45
−51.082	28.35	−10.183	348.06	6.800	757.37
−41.023	58.32	− 2.978	491.22	6.858	758.62
−31.082	110.58				

Boiling point

6°88	Aston, Eidinoff, etc. (1939)
7°3	Lecat

Melting point

−92°19	Aston, Eidinoff, etc. (1939)

Density

t°	d		t°	d	
0	0.67862	Swift Jr. (1942)	25	0.64964	Swift Jr. (1942)
15	1.66158	„	35	0.63732	„

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	207	Swift Jr. and Wolfe	15	17.61	Swift Jr. and Calkins
25	186	„ (1944)	25	16.33	„ (1943)
35	167	„	35	15.08	„

Specific heat: Aston, Eidinoff and Forster (1939)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −258.84	0.0154	−193.09	0.23706	−125.52	0.36431	−57.81	0.69251
−255.03	0.02730	−187.52	0.24906	−121.23	0.7096	−52.98	0.69832
−252.15	0.03924	−183.16	0.25061	−120.26	0.37250	−48.33	0.70196
−249.33	0.04988	−182.33	0.26097	−116.22	0.37915	−43.52	0.70626
−246.44	0.05971	−178.07	0.26239	−115.35	0.37981	−38.20	0.70926
−243.33	0.07415	−173.26	0.27273	−111.18	0.38483	−32.94	0.71219
−239.66	0.08881	−168.66	0.28295	−110.60	0.38543	−27.46	0.71425
−235.64	0.1052	−164.28	0.30079	−106.47	0.39268	−22.36	0.71500
−231.14	0.1241	−160.06	0.30870	−101.44	0.39958	−17.33	0.71711
−226.99	0.1380	−154.37	0.31866	− 97.05	0.40938	−12.35	0.71804
−223.44	0.1495	−149.46	0.32725	L. − 88.34	0.64314	− 7.33	0.72017
−219.32	0.1642	−144.61	0.33486	− 82.97	0.65336	− 2.42	0.72146
−214.33	0.1795	−140.12	0.34253	− 77.72	0.66315	+ 2.39	0.72394
−208.84	0.1952	−135.66	0.34910	− 72.59	0.67177	7.29	0.72514
−203.36	0.2112	−130.81	0.35655	− 67.56	0.67983		
−198.37	0.22442	−126.40	0.36218	− 62.64	0.68608		

Heat of vaporisation	(B.P.) 140.47 cal 15°/g	Aston, Eidinoff and Forster (1939)
Heat of melting	31.514 „	„

DIETHYLAMINE $(C_2H_5)_2NH$

Constants

Saturated vapour pressure: Pohland and Mehl (1933)

t°	p mm	t	p mm	t°	p mm
−41.1	5.9	−12.4	35.1	12.8	127.3
−28.9	12.8	0.0	70.0	20.7	194.4

Boiling point

55°5	Marshall (1906)
55°9	Lecat

Melting point

−50°	Somerville (1931)
−50°	Pohland and Mehl (1933)

Density

t°	d	
0	0.72513	Swift Jr. (1942)
15	0.709435	„
25	0.69894	„
35	0.68815	„

Surface tension

t°	γ	
15	20.63	Swift Jr. and Calkins
25	19.39	„ (1943)
35	18.20	„

TRIMETHYLAMINE $(CH_3)_3N$

Constants: Aston, Sagenkahn, Szasz, Moessen and Zuhr (1944)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm
−80.325	6.04	−41.784	94.12	−20.174	288.03	−3.123	601.61
−74.091	10.25	−35.627	132.64	−15.984	348.82	+0.770	701.27
−62.349	25.16	−28.517	192.20	−11.432	426.05	2.918	761.51
−51.948	50.83	−24.165	238.31	− 8.995	472.83	+3.444	777.15
−46.852	69.79	−23.077	251.23	−7.409	505.14		
0	683	30	1946	Swift Jr. and Hochanadel (1945)			
15	1189	35	2266	„			
20	1415	40	2621	„			
25	1663			„			

Boiling point: +2°87 *Melting point:* −117°08

Viscosity

t°	$\eta \cdot 10^5$	
15	194	Swift Jr. and Wolfe (1944)
25	177	„
35	161	„

Specific heat: (M.W. 59.112)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −261.28	0.00890	−198.50	0.19397	−144.38	0.2987	−61.35	0.4835
−259.17	0.0127	−193.68	0.20317	−143.71	0.3003	−56.47	0.4865
−257.12	0.02100	−191.61	0.2071	−138.86	0.3094	−51.44	0.4884
−254.24	0.03209	−185.41	0.2189	−133.80	0.3216	−46.40	0.4913
−251.59	0.04348	−183.29	0.2225	−128.74	0.3524	−41.40	0.4943
−247.95	0.05889	−180.02	0.2292			−36.21	0.5001
−243.24	0.07927	−178.72	0.2321	L. −124.74	0.4481	−32.54	0.5026
−239.24	0.09379	−174.82	0.2409	−112.28	0.4666	−31.03	0.5038
−234.72	0.1086	−173.71	0.2426	−107.08	0.4676	−27.28	0.5067
−230.92	0.1202	−168.88	0.2509	−101.96	0.4681	−14.50	0.5175
−225.98	0.1332	−166.17	0.2563	− 96.87	0.4703	− 8.78	0.5232
−220.80	0.1447	−163.66	0.2614	− 91.45	0.4728	− 2.71	0.5285
−215.73	0.1560	−158.43	0.2713	− 70.96	0.4784	+ 2.74	0.5329
−214.49	0.1585	−155.53	0.2774	− 66.23	0.4808		
−210.25	0.1673	−153.29	0.2818				
−203.53	0.18272	−148.53	0.2913				

Heat of vaporisation	(B.P.) 92.799 cal 15°/g (23°16) 98.558 „	
Heat of melting	26.473 „	

TRIETHYLAMINE $(C_2H_5)_3N$

Constants: B.E. (1932)

Boiling point: 89°35 $\frac{dt}{dp}$ *(10 mm):* 0°42 B.E. (1932) and Lecat

Freezing point: −114°7

Critical solution point in water: 18°20

Density

t°	d		t°	d	
0	0.74620	B.E. (1932)	12.52	0.7348	Friend and Hargreaves
15	0.73255	„	49.6	0.6999	„ (1944)
30	0.71899	„	60.7	0.6900	„
			70.5	0.6794	„
			80.0	0.6704	„
			85.9	0.6650	„

Viscosity

t°	$\eta \cdot 10^5$	
15	394	B.E. (1932)
30	323	„

Surface tension

t°	γ	
15	21.25	B.E. (1932)
20	20.66	„
30	19.62	„
0	22.92	Merzlin (1935)
15	21.08	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.40080	1.40133	1.40368	1.40835	1.40969	1.41317
$\frac{dn}{dt}$	0.00054	54	54	54	55	55

Dielectric constant

t°	ε		t°	ε	
12.5	3.704	Friend and Hargreaves	70.5	2.316	Friend and Hargreaves
49.6	2.760	„ (1944)	80.0	2.137	„ (1944)
60.7	2.520	„	85.9	2.028	„

n-PROPYLAMINE: *n*-$C_3H_7NH_2$: *Critical constants, saturated vapour pressure* and *boiling point:* Berthoud (1917); *boiling point:* Lecat (passim); *density* and *refractive index:* Eykman (1893–1919).

n-BUTYLAMINE: *n*-$C_4H_9NH_2$ and *n*-HEPTYLAMINE: *n*-$C_7H_{15}NH_2$: *Boiling point, density* and *viscosity:* Friend and Hargreaves (1944); *density, refractive index:* Eykman (1893–1919).

n-ALKYLAMINE: R NH_2(R=*n*-C_6H_{13} → *n*-$C_{18}H_{37}$): *Boiling point* and *saturated vapour pressure:* Ralston, Selby, Pool and Potts (1940).

DI-*n*-PROPYLAMINE: (*n*-$C_3H_7)_2NH$ and DI-*n*-BUTYLAMINE: (*n*-$C_4H_9)_2NH$: *Density* and *dielectric constant:* Friend and Hargreaves (1944).

TRI-*n*-BUTYLAMINE: (*n*-$C_4H_9)_3N$ TRI-*n*-AMYLAMINE: (*n*-$C_5H_{11})_3N$ and TRI-*iso*-AMYLAMINE: $[(CH_3)_2CH.CH_2.CH_2]_3N$: *Specific volume* and *fluidity:* Bingham and Spooner (1932).

ETHYLENEDIAMINE: $NH_2CH_2.CH_2NH_2$: *Boiling point:* (Lecat, passim); *density* and *refractive index:* Brühl (1895); *density* and *viscosity:* Friend and Hargreaves (1944).

B. HYDROGEN CYANIDE; NITRILES

HYDROGEN CYANIDE HCN

Purified by fractional distillation over P_2O_5.

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
S. −85.01	0.132	−51.26	7.48	−19.08	96.26	SINOZAKI, HARA and MITSUKURI (1926)
−78.58	0.376	−46.10	11.78	−18.64	97.97	„
−73.34	0.745	−44.08	13.92	−15.27	131.29	„
−66.66	1.562	−39.97	19.72	−15.23	131.93	„
−65.99	1.673	−34.23	31.24	−13.92	134.29	„
−60.69	2.97	−29.14	46.26	−13.54	137.45	„
−55.58	4.97	−24.32	66.03			„
L. −13.18	140.78	+0.08	265.2	24.65	730.6	„
−13.03	142.32	4.09	316.8	27.68	816.2	„
−11.98	149.80	6.97	358.6	30.25	911.1	„
−10.98	157.58	10.99	407.8	33.98	1028.4	„
−10.25	163.16	13.17	465.4	36.68	1128.2	„
− 7.47	186.54	15.88	519.4	40.15	1272.2	„
− 4.14	219.81	18.87	584.7	42.92	1393.2	„
− 0.70	256.31	21.80	654.4	46.29	1564.1	„
L. −8.017	181.70	+3.121	304.11	16.829	540.43	RUEHRWEIN and GIAUQUE (1939)
−5.083	209.15	6.990	360.03	22.085	658.73	„
−1.096	251.78	11.920	442.84	25.701	760[illegible]6	„
0	265.0	—	—	—	—	SMYTH and MAC ALPINE (1934)

Boiling point

25°70	RUEHRWEIN and GIAUQUE (1939)	25°7	COATES and TAYLOR (1936)
25°70	SINOZAKI, HARA and MITSUKURI (1926)	25°75	LOWRY and HENDERSON (1932)
25°7	LECAT	25°93	SMYTH and MAC ALPINE (1934)

Freezing point

−13°27	COATES and COATES (1944)	−13°35	COATES and TAYLOR (1936)
−13°3	COATES and HARTSHORE (1931)	−13°35	LOWRY and HENDERSON (1932)
−13°34	LESPIEAU (1905)	−13°40	TAMMANN (1899)

Triple point

−13°244	140.40 mm	Ruehrwein and Giauque (1939)

Density

t°	d		t°	d	
10.0	0.7018	Meyer and Hopff (1931)	18	0.69004	Coates and Hartshore (1931)
18	0.68998	Coates and Taylor (1936)	20	0.6876	Lowry and Henderson (1932)

Viscosity $\eta \cdot 10^5$: 18° 206 Coates and Taylor (1932)

Refractive index

t°	Li (6707.36)	D	Hg (4358.24)	
20	1.25994	1.26136	1.26700	Lowry and Henderson (1932)

Specific heat: Ruehrwein and Giauque (1939)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −258.33	0.0138	−198.42	0.2379	−129.48	0.3658	−82.80	0.4264
−256.25	0.0194	−193.31	0.2515	−124.35	0.3716	−76.78	0.4353
−254.16	0.0276	−188.17	0.2650	−123.78	0.3746	−71.00	0.4449
−251.46	0.03750	−183.15	0.2760	−119.06	0.3801	−65.34	0.4523
−247.28	0.05267	−178.13	0.2857	−115.21	0.3857	−59.67	0.4623
−243.31	0.06678	−171.04	0.3008	−113.81	0.3864	−48.36	0.4842
−240.25	0.08262	−166.16	0.3090	−108.67	0.3931	−42.16	0.4967
−237.00	0.09650	−161.50	0.3183	−106.80	0.3961	−36.44	0.5097
−233.67	0.1112	−156.25	0.3270	−106.70	0.3968	−30.59	0.5215
−229.67	0.1287	−150.62	0.3344	−100.37	0.4046	−24.67	0.5356
−225.43	0.1458	−148.43	0.3376	− 98.68	0.4053	−18.96	0.5475
−221.38	0.1633	−145.17	0.3422	− 97.29	0.4057	L. − 1.34	0.6226
−217.95	0.1805	−139.91	0.3499	− 96.06	0.4075	+ 4.05	0.6233
−212.57	0.1953	−139.76	0.3505	− 95.52	0.4086	20.92	0.6270
−208.10	0.2083	−134.68	0.3565	− 91.59	0.4142	24.02	0.6278
−203.29	0.2236	−132.00	0.3620	− 89.49	0.4164		

Heat of vaporisation	(B.P.) 223.1 cal 15°/g	Ruehrwein and Giauque (1939)
Heat of melting	74.38 „	„

NITRILES

The nitriles are prepared by dehydration of the corresponding amides by P_2O_5; this method yields a very pure product.

Another method consists in treating the iodide or bromide of the next lower homologue with alkaline cyanide; in this case, the product is contaminated with isonitrile, but this impurity can be eliminated by shaking with *0.1 N* hydrochloric acid.

The series of homologous normal nitriles from C_2 to C_{14} was studied with great care by MERCKX, VERHULST and BRUYLANTS in (1933) and their results agree well with those obtained by the B.E. (1930). Yet the densities, although in complete agreement at 15°, differ slightly at 0° and 30°. As for the refractive indices, the results of various collaborators at Brussels are in perfect concordance; we found, however, a systematic difference with the values given at Louvain. Nevertheless the values of the saturated vapour pressure agree perfectly. It follows that the discrepancies arise more probably from a systematic error either during the experiments or in calibrating the apparatus, rather than from the degree of purity of the materials; on the other side, the vapour pressure curve of HEIM (1933) does not always agree with the boiling point measurements of his colleagues of Louvain.

ACETONITRILE CH_3CN

Constants: B.E. (1930). — **Polyphasic equilibria**

Critical constants

t° cr.	d cr.	
274.74	0.2371	TER GAZARIAN (1906)

Densities of the liquid and the saturated vapour: TER GAZARIAN (1906)

t°	L.	V.	t°	L.	V.
212.34	0.5340	0.0248	245.77	0.4527	0.0589
213.46	0.5301	0.0271	249.02	0.4403	0.0660
218.83	0.5147	0.0331	252.01	0.4291	0.0728
223.15	0.5066	0.0358	262.00	0.3932	0.0963
227.72	0.4983	0.0388	264.17	0.3796	0.1073
232.61	0.4863	0.0438	266.61	0.3654	0.1162
236.52	0.4756	0.0480	269.00	0.3502	0.1288
240.50	0.4637	0.0538	269.98	0.3425	0.1377
243.04	0.4594	0.0554	270.92	0.3355	0.1455

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
15.5	54.9	20.5	70.6	—	—	Joukovsky (1934)
18.0	62.2	22.8	78.6	—	—	„
20	70.9	25	89.0	30	111.8	Ewert (1937)
19.99	70.7	49.48	249.1	79.46	707.3	Heim (1933)
25.50	91.4	54.44	300.3	89.66	970.5	„
30.05	111.7	59.65	363.2	94.52	1117.9	„
34.88	137.8	64.95	437.4	99.89	1303.9	„
39.45	166.7	70.05	521.6	104.30	1473.2	„
44.50	205.2	74.77	613.1			„

Boiling point

81°52	Merckx, Verhulst and Bruylants (1933)	81°60	Koch (1927)
		81°6	Cowley and Partington (1935)
81°54	Louguinine (1900–1899)	81°6	Lecat
81°60	B.E. (1930)	81°7	Radice (1899)
81°60	Grimm and Patrick (1923)	81°73	Heim (1933)

$\frac{dt}{dp}$*(10 mm):* *Freezing point*

0°35	Lecat	−44°9	B.E. (1930)
0°40	B.E. (1930)	−45°	Joukovsky (1934)
0°43	Heim (1933)	−45°2	Ewert (1937)

Constants of state

Density

t°	d	t°	d	t°	d	
−45.0	0.85124	−30.6	0.83592	− 6.2	0.81013	Timmermans (1912)
−37.2	0.84288	−22.95	0.82774	0	0.80350	„
−35.3	0.84074	−13.1	0.81724	+18.2	0.78417	„
0	0.8034	Ter Gazarian		0	0.80345	B.E. (1930)
13.4	0.7893	„ (1906)		15	0.78746	„
23.4	0.7784	„		30	0.77141	„

Density (continued)

t°	d		t°	d	
0	0.80345	Ewert (1937)	0	0.80377	Merckx, Verhulst and Bruylants (1933)
15	0.78746	„	15	0.78743	
30	0.77148	„	30	0.77125	„
0	0.80345	Joukovsky (1934)	20	0.7822	Groves and Sugden (1937)
0	0.8036	Radice (1899)	20	0.7823	Cowley and Partington (1935)
0	0.8036	Walden (1908)			

Viscosity

t°	$\eta \cdot 10^5$	
15	375	
30	325	

Surface tension

t°	γ	
15	29.76	
20	29.10	
30	27.80	

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.34436	1.34464	—	1.34638	1.34964	1.35055	1.35306	1.35396	B.E. (1930)
$\frac{dn}{dt}$	0.00045	46	—	45	45	47	45	47	„
15	1.34415	1.34451	1.34604	1.34615	1.34943	1.35030	1.35258	1.35357	Merckx etc. (1933)
30	1.33749	1.33767	1.33934	1.33933	1.34257	1.34326	1.34565	1.34667	„
$\frac{dn}{dt}$	0.00044	46	45	46	46	47	47	47	„
15	1.34431	—	—	1.34643	1.34963	—	1.35305	—	Ewert (1937)
15	1.34433	—	—	1.34640	1.34974	—	1.35306	—	Joukovsky (1934)
20	—	—	1.3438	—	—	—	—	—	Cowley and Partington (1935)

PROPIONITRILE C_2H_5CN

Constants: B.E. (1934)

Critical constants

t° cr.	d cr.	
291°2–291°3	0.2401	Ter Gazarian (1906)

Saturated vapour pressure: I Heim (1933) and II Dreisbach and Shrader (1949)

	t°	p mm	t°	p mm	t°	p mm	t°	p mm
I	20.10	37.4	49.99	145.2	79.80	436.2	109.86	109.79
	24.55	46.7	55.32	180.5	85.34	525.2	114.87	126.32
	29.85	59.9	60.00	215.4	90.20	612.8	120.74	147.56
	34.48	74.5	65.88	268.3	94.61	702.6		
	39.47	92.8	70.30	315.0	99.93	823.4		
	45.19	119.4	75.16	373.3	104.85	951.5		
II	35.5	75.86	45.76	123.76	70.45	315.52	84.44	507.50

Boiling point

97°13	Heim (1933)	97°17	Merckx, Verhulst and Bruylants (1933)
97°14	Groves and Sugden (1937)	97°20	$\frac{dt}{dp}$ *(10 mm):* 0°43 B.E. (1934) and Lecat
97°15	Schiff (1886)	97°35	„ 0.°4379 Dreisbach and Martin (1949)
97°16	Louguinine (1900)		

Freezing point

−91°4	Joukovsky (1934)	−91°9	B.E. (1934)
−91°85	Timmermans (1923)		

Density

t°	d		t°	d	
15	0.78673	B.E. (1934)	0	0.80199	Merckx, Verhulst
0	0.80200	Timmermans (1923)			and Bruylants (1933)
0	0.8020	Ter Gazarian (1906)	15	0.78673	„
20	0.78182	Dreisbach and Martin	30	0.77163	„
25	0.77682	„ (1949)	25	0.7770	Walden (1908)
30	0.77152	Daragan (1935)	50	0.7515	„
40.83	0.76010	„	70.15	0.72930	Daragan (1935)
40.88	0.76019	„	70.20	0.72924	„
49.75	0.75070	„	79.80	0.71892	„
49.90	0.75075	„	80.35	0.71830	„
58.60	0.74141	„	90.15	0.70768	„
60.05	0.74008	„	90.95	0.70702	„
			99.15	0.69837	„

$d_t = 0.80200 - 101.7 \cdot 10^{-5}\, t^\circ - 48.3 \cdot 10^{-8}\, t^{\circ 2}$ Timmermans (1923)

Viscosity

t°	$\eta \cdot 10^5$	
15	454	B.E. (1934)
30	389	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.36607	1.36641	—	1.36830	1.37187	1.37275	1.37557	—	B.E. (1934)
$\frac{dn}{dt}$	0.00044	45	—	45	45	45	45	—	„
15	1.36604	1.36629	1.36812	1.36826	1.37171	1.37257	1.37521	1.37620	MERCKX, etc. (1933)
30	1.35930	1.35958	1.36132	1.36136	1.36483	1.36562	1.36819	1.36923	„
$\frac{dn}{dt}$	0.00045	45	45	46	46	46	47	46	„
20	1.36400	1.36425	1.36585	1.36596	1.36943	1.37025	1.37289	1.37390	DARAGAN (1935)

n-BUTYRONITRILE n-C_3H_7CN

Constants: B.E. (1934)

Saturated vapour pressure: HEIM (1933)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
20.40	15.2	55.10	85.0	85.20	276.3	114.85	708.5
25.06	18.6	59.86	104.5	90.10	327.6	120.59	834.4
30.54	26.7	65.02	128.2	95.24	388.3	125.40	948.2
35.04	32.0	70.65	160.0	99.65	447.6	129.93	1070.6
40.05	42.5	75.12	186.8	104.90	525.7	135.00	1224.1
45.04	54.5	79.96	229.5	110.10	617.6	141.85	1457.6
49.90	67.6						

Boiling point

117°28	$\frac{dt}{dp}$ *(10 mm)*: 0°46 HEINE (1933)
117°55	MERCKX, VERHULST and BRUYLANTS (1933)
117°9	LECAT
117°94	$\frac{dt}{dp}$ *(10 mm)*: 0°47 B.E. (1934)

Freezing point

−111°9	B.E. (1934)
−112°	JOUKOVSKY (1934)

Density

t°	d		t°	d	
0	0.80912	B.E. (1934)	30	0.78165	DARAGAN (1935)
15	0.79544	„	40.55	0.77159	„
30	0.78183	„	50.20	0.76232	„
0	0.80919	MERCKX, VERHULST and BRUYLANTS (1933)	60.55	0.75218	„
			68.00	0.74385	„
15	0.79542	„	79.85	0.73314	„
30	0.78172	„	87.65	0.72545	„
			95.60	0.71762	„

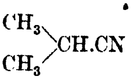
Viscosity

t°	$\eta \cdot 10^5$	
15	624	B.E. (1934)
30	515	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.38382	1.38422	—	1.38623	1.38988	1.39090	1.39376	—	B.E. (1934)
$\frac{dn}{dt}$	0.00041	43	—	42	41	42	43	—	„
15	1.38373	1.38394	1.38600	1.38617	1.38965	1.39063	1.39344	1.39429	Merckx, etc. (1933)
30	1.37737	1.37760	1.37954	1.37967	1.38329	1.38405	1.38685	1.38795	„
$\frac{dn}{dt}$	0.00042	42	43	43	42	44	44	42	„
20	1.38163	1.38183	1.38385	1.38402	1.38755	1.38844	1.39124	1.39218	Daragan (1935)
20	—	—	1.3842	—	—	—	—	—	Dorinson and Ralston (1944)
25	—	—	1.3820	—	—	—	—	—	
30	—	—	1.3798	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00044	—	—	—	—	—	„

Iso-BUTYRONITRILE


$$\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>CH.CN$$

Constants: B.E. (1934)

Boiling point

103°7	De Hoffmann and Barbier (1936)
103°85	$\frac{dt}{dp}$ *(10 mm)*: 0°46 B.E. (1934) and Lecat

Freezing point

−71°5	B.E. (1934)

Density

t°	d		t°	d	
0	0.78942	B.E. (1934)	15	0.77525	De Hoffmann and Barbier
15	0.77511	„	20	0.77037	„ (1936)
30	0.76082	„	30	0.76060	„

Viscosity

t°	$\eta \cdot 10^5$	
15	551	B.E. (1934)
30	456	„

Surface tension

t°	γ	
15	25.48	B.E. (1934)
20	24.93	„
30	23.84	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.37354	1.37386	1.37563	1.37584	1.37942	1.38046	1.38324	—	B.E. (1934)
$\frac{dn}{dt}$	0.00044	43	—	43	43	44	44	—	„
15	—	1.37365	1.37553	—	—	1.38003	—	1.38356	De Hoffmann and Barbier (1936)
30	—	1.36724	1.36904	—	—	1.37353	—	1.37685	„
$\frac{dn}{dt}$	—	43	43	—	—	43	—	—	„

n-VALERONITRILE n-C_4H_9CN

Constants: B.E. (1934)

Saturated vapour pressure: Heim (1933)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
20.20	5.4	79.84	105.0	110.02	304.0	140.81	761.2
30.11	10.2	85.10	128.8	115.42	363.3	145.28	858.8
40.33	17.4	90.45	157.5	120.20	421.2	150.19	977.4
50.17	28.4	95.12	186.1	125.30	489.6	155.35	1100.8
60.06	45.1	100.34	223.3	130.00	561.7	159.95	1249.5
70.30	70.5	105.01	257.8	135.00	648.5	166.48	1458.8
75.15	86.8						

Boiling point

140°75	Lievens (1924)
140°75	$\frac{dt}{dp}$ *(10 mm)*: 0°51 Heim (1933)
140°80	„ 0°49 B.E. (corr. B.E. (1934))
141°3	Lecat

Freezing point

−96°0	B.E. (1934)
−96°	Joukovsky (1934)

Density

t°	d		t°	d	
0	0.81625	B.E. (1934)	30.00	0.79055	Daragan (1935)
15	0.80350	„	40.40	0.78133	„
30	0.79087	„	49.40	0.77315	„
0	0.81627	Ewert (unpubl.)	59.45	0.76409	„
15	0.80345	„	69.25	0.75532	„
30	0.79053	„	79.45	0.74589	„
0	0.81636	Merckx, etc. (1933)	88.75	0.73740	„
15	0.80348	„	99.05	0.72785	„
30	0.79062	„			

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
15	779		15	28.01	
30	637		20	27.44	
			30	26.33	

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.39706	1.39735	—	1.39950	1.40338	1.40436	1.40736	—	corr. B.E. (1934)
$\frac{dn}{dt}$	0.00041	41	—	40	40	41	43	—	,,
15	1.39712	—	—	1.39957	1.40345	—	1.40743	—	EWERT (unp.)
15	1.39701	1.39720	1.39913	1.39930	1.40318	1.40398	1.40692	1.40793	MERCKX, etc. (1933)
30	1.39081	1.39117	1.39307	1.39318	1.39701	1.39790	1.40067	1.40180	,,
$\frac{dn}{dt}$	0.00041	40	40	40	41	40	41	40	,,
20	1.39497	1.39519	1.39711	1.39725	1.40113	1.40195	1.40487	1.40589	DARAGAN (1935)
20	—	—	1.3972	—	—	—	—	—	DORINSON and RALSTON (1944)
25	—	—	1.3950	—	—	—	—	—	,,
30	—	—	1.3929	—	—	—	—	—	,,
$\frac{dn}{dt}$	—	—	0.00043	—	—	—	—	—	,,

Iso-VALERONITRILE $(CH_3)_2CH.CH_2CN$

Constants: B.E. (1934)

Boiling point *Freezing point*

130°3	$\frac{dt}{dp}$ *(10 mm)*: 0°46	−100°85	
130°5	LECAT		

Density *Viscosity* *Surface tension*

t°	d		t°	$\eta \cdot 10^5$		t°	γ	
0	0.80797		15	850		15	26.53	
15	0.79490		30	677		20	25.93	
30	0.78188					30	24.89	

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.39301	1.39331	1.39545	1.39930	1.40027	1.40348
$\frac{dn}{dp}$	0.00042	42	43	43	43	44

n-CAPRONITRILE $n\text{-}C_5H_{11}CN$

Constants

Saturated vapour pressure: HEIM (1933)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
19.90	2.3	90.20	71.3	124.95	246.1	159.88	692.6
30.17	3.9	94.72	85.3	129.61	285.2	165.21	799.1
40.26	6.8	100.15	105.6	134.90	337.0	169.95	901.3
50.30	11.7	105.01	125.1	140.00	392.6	175.20	1026.2
60.05	19.2	109.82	149.0	145.30	459.1	179.60	1145.4
70.43	30.9	114.70	176.0	150.00	524.5	185.5	1310
80.20	47.0	120.25	212.8	155.40	613.0		

Boiling point: 163°32 $\frac{dt}{dp}$ (10 mm): 0°51 HEIM (1933)
163°9 LECAT
164°05 MERCKX, VERHULST and BRUYLANTS (1933)

Freezing point: −79°4 TIMMERMANS

Density

t°	d		t°	d·	
0	0.82171	MERCKX, VERHULST and BRUYLANTS (1933)	49.90	0.78036	DARAGAN (1935)
			59.95	0.77168	„
15	0.80942	„	69.20	0.76376	„
30	0.79713	„	79.40	0.75510	„
30.00	0.79704	DARAGAN (1935)	87.85	0.74807	„
39.30	0.78873	„	97.15	0.74005	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.40663	1.40687	1.40892	1.40909	1.41298	1.41394	1.41692	1.41786	MERCKX, etc. (1933)
30	1.40073	1.40098	1.40298	1.40305	1.40690	1.40799	1.41087	1.41193	„
$\frac{dn}{dt}$	0.00039	39	39	40	40	39	40	39	„
20	1.40463	1.40491	1.40694	1.40709	1.41098	1.41189	1.41492	1.41590	DARAGAN (1935)
20	—	—	1.4069	—	—	—	—	—	DORINSON and RALSTON (1944)
25	—	—	1.4049	—	—	—	—	—	
30	—	—	1.4028	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00041	—	—	—	—	—	„

Iso-CAPRONITRILE $(CH_3)_2CH(CH_2)_2CN$

Constants

Freezing point: −51°1 Timmermans

Density *Surface tension*

t°	d		t°	γ	
20	0.8038	Turner and Merry(1910)	20	26.53	Turner and Merry (1910)
30	0.7955	„	30	25.61	„
45	0.7827	„	45	24.23	„
60	0.7699	„	60	22.84	„
14.2	0.8075	Eykman (1893)			

n-OENANTHONITRILE $n\text{-}C_6H_{13}CN$

Constants

Saturated vapour pressure: Heim (1933)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
20.00	1.5	89.50	36.1	134.60	186.0	169.94	525.5
29.60	2.4	99.51	53.6	139.78	219.3	174.79	599.3
40.85	3.5	109.55	79.0	144.89	257.3	180.40	692.5
49.60	5.6	114.84	95.7	149.64	296.9	185.30	780.3
59.86	9.3	119.92	114.8	154.70	346.4	190.85	893.0
69.92	15.1	125.10	135.7	159.95	400.4	194.70	980.5
79.86	23.7	129.95	160.0	164.58	454.6	199.30	1109.2

Boiling point: 184°20 $\frac{dt}{dp}$ (10 *mm*)*:* 0°56 Heim (1933)

184°57 Merckx, Verhulst and Bruylants (1933)

Density

t°	d	t°	d	t°	d	
30.00	0.80171	57.95	0.77866	88.00	0.75402	Daragan (1935)
40.12	0.79343	69.55	0.76922	98.50	0.74525	„
49.75	0.78538	80.20	0.76047			„
0	0.82524	Merckx, Verhulst and Bruylants (1933)				
15	0.81348	„				
30	0.80177	„				

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.41381	1.41409	1.41610	1.41626	1.42035	1.42128	1.42433	1.42545	MERCKX, VERHULST and BRUYLANTS
30	1.40802	1.40836	1.41037	1.41039	1.41442	1.41542	1.41837	1.41958	„ (1933)
$\frac{dn}{dt}$	0.00039	39	39	39	39	39	39	39	„
20	1.41191	1.41218	1.41419	1.41431	1.41840	1.41931	1.42238	1.42349	DARAGAN (1935)
20	—	—	1.4144	—	—	—	—	—	DORINSON and RALSTON (1944)
25	—	—	1.4124	—	—	—	—	—	„
30	—	—	1.4104	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00040	—	—	—	—	—	„

n-CAPRYLONITRILE n-$C_7H_{15}CN$

Constants

Saturated vapour pressure: HEIM (1933)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
20.13	0.3	100.43	25.1	144.75	137.4	180.00	402.9
40.25	0.8	109.98	37.7	149.50	160.9	185.10	461.0
50.20	1.7	120.90	58.9	155.40	195.9	190.49	530.1
60.30	3.3	125.60	70.0	160.61	228.1	195.42	603.6
70.44	5.8	130.40	82.8	164.71	259.2	200.04	678.7
80.35	9.9	134.91	97.7	169.89	301.3	204.58	760.2
89.72	15.8	139.75	115.9	175.10	350.3		

Boiling point *Freezing point*

204°57	$\frac{dt}{dp}$ *(10 mm):* 0°56 HEIM (1933)	−45°6	TIMMERMANS
205°2	„ 0°57 DEFFET (1931)		

Density

t°	d		t°	d	
0	0.82862	DEFFET (1931)	0	0.82871	MERCKX, VERHULST and BRUYLANTS (1933)
15	0.81725	„			
30	0.80581	„	15	0.81739	„
			30	0.80586	„
30.00	0.80582	DARAGAN (1935)	70.90	0.77360	DARAGAN (1935)
40.83	0.79735	„	80.05	0.76640	„
49.75	0.79026	„	90.35	0.75813	„
59.55	0.78260	„	99.15	0.75129	„

Viscosity

t°	$\eta \cdot 10^5$	
15	1811	Deffet (1931)
30	1336	"

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.41975	1.42003	1.42211	1.42227	1.42628	1.42738	1.43039	1.43165	Merckx, etc. (1933)
30	1.41405	1.41428	1.41632	1.41661	1.42070	1.42137	1.42461	1.42567	"
$\frac{dn}{dt}$	0.00038	38	39	38	37	40	38	39	"
20	1.41789	1.41811	1.42018	1.42037	1.42443	1.42538	1.42849	1.42962	Daragan (1935)
20	—	—	1.4204	—	—	—	—	—	Dorinson and Ralston (1944)
25	—	—	1.4183	—	—	—	—	—	"
30	—	—	1.4164	—	—	—	—	—	"
$\frac{dn}{dt}$	—	—	0.00040	—	—	—	—	—	"
15	1.41980	1.42016	—	1.42240	1.42663	1.42766	1.43065	1.43187	Deffet (1931)
$\frac{dn}{dt}$	0.00039	39	—	40	40	41	40	—	"

n-PELARGONITRILE $n\text{-}C_8H_{17}CN$

Constants

Boiling point: 224°0 Deffet (1931)

Freezing point: −34°2 Deffet (1931)

Density

t°	d		t°	d	
0	0.83181	Deffet (unp.)	0	0.83180	Merckx, Verhulst and Bruylants (1933)
30	0.80944	corr. Deffet (1931)			
			15	0.82061	"
30.00	0.80946	Daragan (1935)	30	0.80947	"
40.95	0.80092	"	78.95	0.77157	Daragan (1935)
51.00	0.79321	"	88.75	0.76402	"
60.55	0.78574	"	99.35	0.75570	"
69.95	0.77860	"	109.00	0.74831	"

Viscosity

t°	$\eta \cdot 10^5$	
15	2340	Deffet (1931)
30	1688	"

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.42476	1.42497	1.42713	1.42719	1.43144	1.43243	1.43547	1.43662	Merckx, etc. (1933)
30	1.41909	1.41934	1.42140	1.42156	1.42579	1.42668	1.42980	1.43092	„
$\frac{dn}{dt}$	0.00038	37	39	37	38	39	38	39	„
20	1.42288	1.42309	1.42522	1.42529	1.42954	1.43051	1.43357	1.43472	Daragan (1935)
20	—	—	1.4254	—	—	—	—	—	Dorinson and Ralston (1944)
25	—	—	1.4235	—	—	—	—	—	„
30	—	—	1.4216	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00038	—	—	—	—	—	„
25	—	—	1.4233	—	—	—	—	—	Ralston, Selby, Pool and Potts (1940)

n-DECANENITRILE $n\text{-}C_9H_{19}CN$

Constants

Freezing point: −14°46 Hoerr, Binkerd, Pool and Ralston (1944)

Density

t°	d		t°	d	
0	0.83429	Merckx, Verhulst and Bruylants (1933)	60.40	0.78976	Daragan (1935)
15	0.82332	„	70.45	0.78249	„
30	0.81240	„	80.35	0.77504	„
40.85	0.80425	Daragan (1935)	89.65	0.76778	„
49.80	0.79771	„	96.05	0.76126	„
			111.00	0.75210	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.42887	1.42917	1.43129	1.43134	1.43563	1.43670	1.43980	1.44108	Merckx, Verhulst and Bruylants
30	1.42341	1.42365	1.42579	1.42599	1.43011	1.43101	1.43421	1.44540	„ (1933)
$\frac{dn}{dt}$	0.00037	37	37	36	37	38	37	38	„
20	1.42707	1.42726	1.42940	1.42954	1.43378	1.43480	1.43790	1.44119	Daragan (1935)
20	—	—	1.4296	—	—	—	—	—	Dorinson and Ralston (1944)
25	—	—	1.4276	—	—	—	—	—	„
30	—	—	1.4256	—	—	—	—	—	„
$\frac{dn}{dt}$	—	—	0.00040	—	—	—	—	—	„

n-NITRILES (from C_{11} to C_{14})

Constants: I MERCKX, VERHULST and BRUYLANTS (1933)
II DARAGAN (1935)
III DORINSON and RALSTON (1944)

	Density					Refractive index			
UNDECANENITRILE $n\text{-C}_{10}\text{H}_{21}\text{CN}$	I		II			II	I		
						20°	15°	30°	$\frac{dn}{dt}\cdot 10^5$
	0°	0.83621	30°	0.81462	He r.	1.43039	1.43218	1.42661	37
	15°	0.82538	41°00	0.80619	Hα	1.43074	1.43255	1.42713	36
	30°	0.81465	49°80	0.79996	D	1.43286	1.43464	1.42929	36
			59°15	0.79309	He y.	1.43299	1.43478	1.42935	36
			69°60	0.78543	He g.	1.43728	1.43903	1.43349	37
			79°70	0.77798	Hβ	1.43825	1.44007	1.43462	36
			88°85	0.77145	He v.	1.44145	1.44323	1.43762	37
			100°15	0.76316	Hγ	1.44254	1.44444	1.43892	37
			110°80	0.75544					
						III			
					D	1.4330	1.4312 (25°)	1.4293	
LAURONITRILE $n\text{-C}_{11}\text{H}_{23}\text{CN}$						II	I		
	0°	0.83815	30°00	0.81680	He r.	1.43346	1.43526	1.42985	36
	15°	0.82744	40°43	0.80918	Hα	1.43378	1.43558	1.43022	36
	30°	0.81685	51°05	0.80160	D	1.43595	1.43774	1.43240	35
			60°60	0.79453	He y.	1.43610	1.43785	1.43256	35
			69°00	0.78838	He g.	1.44030	1.44220	1.43663	37
			79°75	0.78060	Hβ	1.44137	1.44323	1.43766	37
			89°35	0.77368	He v.	1.44450	1.44640	1.44081	37
			96°05	0.76676	Hγ	1.44586	1.44776	1.44206	38
			109°80	0.75905					
						III			
					D	1.4360	1.4341 (25°)	1.4322	
TRIDECANENITRILE $n\text{-C}_{12}\text{H}_{25}\text{CN}$						II	I		
	15°	0.82937	30°08	0.81875	He r.	1.43615	1.43793	1.43257	36
	30°	0.81887	40°15	0.81130	Hα	1.43653	1.43835	1.43289	36
			49°30	0.80491	D	1.43867	1.44045	1.43512	36
			60°17	0.79700	He y.	1.42873	1.44056	1.43518	36
			69°85	0.79032	He g.	1.44303	1.44499	1.43932	37
			80°15	0.78297	Hβ	1.44417	1.44605	1.44040	37
			89°85	0.77596	He v.	1.44736	1.44933	1.44362	37
			100°15	0.76879	Hγ	1.44862	1.45048	1.44492	37
			111°05	0.76098					
						III			
					D	1.4384	1.4368 25°	1.4349	

(continued)	*Density*				*Refractive index*			
MYRISTONITRILE n-$C_{13}H_{27}CN$	I		II			II	I	
						20°	15°	30°
	30°	0.82065	42°91	0.81188	He r.	1.43854	—	1.43487
			49°85	0.80683	Hα	1.43923	—	1.43522
			59°60	0.80000	D	1.44126	—	1.43741
			69°65	0.79291	He y.	1.44137	—	1.43741
			81°10	0.78486	He g.	1.44568	—	1.44174
			89°55	0.77873	Hβ	1.44682	—	1.44289
			100°72	0.77080	He v.	1.45004	—	1.44601
			109°95	0.76431	Hγ	1.45129	—	1.44735
			120°60	0.75638				
			132°50	0.74817			III	
					D	1.4410	1.4392 25°	1.4373

PENTADECANENITRILE: n-$C_{14}H_{29}CN$

PALMITONITRILE: n-$C_{15}H_{31}CN$

MARGARONITRILE: n-$C_{16}H_{33}CN$

STEARONITRILE: n-$C_{17}H_{35}CN$

Refractive index: DORINSON and RALSTON (1944)

METHYL n-NITRILES (from C_5 to C_{15}) $RCH(CH_3)CN$

Constants: DE HOFFMANN and BARBIER (1936)

	B.P.	*Density*		*Refractive index*			
		15°	30°		15°	30°	$\frac{dn}{dt}$
$R = n$-C_2H_5	125°4	0.79128	0.77780	Hα	1.38998	1.38370	0.00042
				D	1.39195	1.38562	42
				Hβ	1.39667	1.39021	43
				Hγ	1.40042	1.39417	43
$R = n$-C_3H_7	147°1	0.79747	0.78472	Hα	1.40001	1.39387	41
				D	1.40204	1.39588	41
				Hβ	1.40688	1.40058	42
				Hγ	1.41070	1.40439	42
$R = n$-C_4H_9	164°7	0.80384	0.79169	Hα	1.40842	1.40266	38
				D	1.41046	1.40467	38
				Hβ	1.41545	1.40965	39
				Hγ	1.41941	1.41345	39

(continued)	*B.P.*	*Density*		*Refractive index*			
		15°	30°		15°	30°	$\frac{dn}{dt}$
$R = n\text{-}C_5H_{11}$	184°7	0.80823	0.79644	Hα	1.41469	1.40906	0.00037
				D	1.41680	1.41121	37
				Hβ	1.42187	1.41616	38
				Hγ	1.42585	1.42007	38
$R = n\text{-}C_6H_{13}$	—	0.81214	0.80074	Hα	1.42020	1.41466	37
				D	1.42226	1.41675	37
				Hβ	1.42745	1.42184	37
				Hγ	1.43165	1.42599	38
$R = n\text{-}C_7H_{15}$	—	0.81561	0.80442	Hα	1.42452	1.41937	34
				D	1.42669	1.42145	35
				Hβ	1.43191	1.42646	36
				Hγ	1.43591	1.43046	36
$R = n\text{-}C_8H_{17}$	—	0.81851	0.80757	Hα	1.42840	1.42310	35
				D	1.43057	1.42543	34
				Hβ	1.43588	1.43046	36
				Hγ	1.44008	1.43473	36
$R = n\text{-}C_9H_{19}$	—	0.82128	0.81031	Hα	1.43171	1.42633	36
				D	1.43387	1.42843	36
				Hβ	1.43920	1.43374	36
				Hγ	1.44349	1.43790	37
$R = n\text{-}C_{10}H_{21}$	—	0.82380	0.81316	Hα	1.43443	1.42923	35
				D	1.43669	1.43150	35
				Hβ	1.44205	1.43668	36
				Hγ	1.44647	—	—
$R = n\text{-}C_{12}H_{25}$	—	0.82765	0.81707	Hα	1.43931	1.43389	36
				D	1.44152	1.43618	36
				Hβ	1.44696	1.44145	37
				Hγ	1.45117	—	—

ACRYLONITRILE: $CH_2{=}CH.CN$: *Saturated vapour pressure, boiling* and *melting points, density, refractive index, specific heat* and *heat of combustion:* DAVIS and WIEDEMAN (1945).

CROTONITRILE $CH_3.CH{=}CH.CN$ *cis*

Constants — *Saturated vapour pressure:* HEIM (1933)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
24.95	31.8	55.09	125.1	84.70	374.1	114.32	926.7
29.85	40.6	60.05	150.6	89.70	440.9	120.30	1091.7
34.85	51.7	64.79	182.1	94.62	516.1	124.58	1211.3
40.23	66.1	69.65	219.3	99.99	606.1	131.79	1464.7
44.83	81.2	74.85	266.3	104.97	706.1		
49.84	100.4	79.80	316.0	109.85	814.3		

Boiling point / *Freezing point*

107°47	$\frac{dt}{dp}$ *(10 mm)*: 0°46 **Heim** (1933)	−72°1	**Timmermans** (passim)
107°77	**Bruylants and Christiaen** (1925)		

Density

t°	d	
0	0.84376	**Heim** (1933)
15	0.82890	„
30	0.81402	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.41683	1.41736	1.42065	1.42072	1.42718	1.42887	1.43376	1.43590	**Heim** (1933)
30	1.40968	1.41021	1.41335	1.41343	1.41982	1.42142	1.42633	1.42852	„
$\frac{dn}{dt}$	0.00047	47	48	48	49	50	50	49	„

Heat of combustion	20°, (c_v) 8516.1 cal 15°/g	**Bruylants and Christiaen** (1925)

Iso-CROTONITRILE $CH_3.CH{=}CH.CN$ *trans*

Constants

Saturated vapour pressure: **Heim** (1933)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
19.20	12.3	54.36	71.0	89.80	279.7	124.79	811.9
25.12	17.3	59.49	88.2	94.99	332.4	130.85	960.1
29.62	22.0	65.18	111.7	99.95	390.4	135.95	1098.6
34.25	27.8	69.90	134.5	104.87	454.6	140.67	1241.1
40.05	37.3	74.89	163.5	109.45	524.5	146.06	1421.6
44.65	45.9	79.80	196.3	114.55	611.1		
50.07	59.0	84.79	234.6	119.52	704.6		

Boiling point / *Freezing point*

121°23	**Bruylants and Christiaen** (1925)	−51°1	**Timmermans** (passim)
122°31	$\frac{dt}{dp}$ *(10 mm)*: 0°50 **Heim** (1933)		

Density

t°	d	
0	0.84046	**Heim** (1933)
15	0.82586	„
30	0.81135	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.42097	1.42140	1.42488	1.42490	1.43180	1.43337	1.43877	1.44074	**Heim** (1933)
30	1.41400	1.41438	1.41775	1.41791	1.42460	1.42617	1.43146	1.43349	„
$\frac{dn}{dt}$	0.00047	47	48	47	48	48	48	49	„

Heat of combustion	20°, (c_v) 8544.8 cal 15°/g	**Bruylants** and **Christiaen** (1925)

VINYLACETONITRILE $CH_2{=}CH.CH_2.CN$

Constants

Saturated vapour pressure: **Heim** (1933)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
15.37	10.8	49.51	62.3	84.78	258.8	120.10	797.2
20.52	14.2	55.06	79.9	89.88	309.2	125.30	921.0
25.03	18.2	60.27	99.9	94.62	363.4	130.10	1047.6
29.65	23.5	65.84	125.3	99.87	431.7	134.86	1191.2
34.75	30.7	70.81	153.4	104.65	500.5	139.60	1349.5
39.85	39.8	74.94	179.7	109.94	589.7	143.46	1489.2
45.22	51.2	79.99	217.2	115.45	697.2		

Boiling point

118°42	$\frac{dt}{dp}$ *(10 mm):* 0°45 **Heim** (1933)
118°52	**Bruylants** and **Christiaen** (1925)

Density

t°	d	
0	0.85286	**Heim** (1933)
15	0.83823	„
30	0.82372	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.40522	1.40572	1.40819	1.40829	1.41324	1.41454	1.41822	1.41983	HEIM (1933)
30	1.39863	1.39900	1.40147	1.40158	1.40645	1.40766	1.41137	1.41290	„
$\frac{dn}{dt}$	0.00044	45	45	45	46	46	46	46	„

Heat of combustion	20°, (c_v) 8561.3 cal 15°/g	BRUYLANTS and CHRISTIAEN (1925)

PENTENE(4)NITRILES $CH_2{=}CH.(CH_2)_2.CN$

Constants: VANDEWYER (1935)

Boiling point: *cis:* 128°0; *trans:* 145°5

Density

cis	15°	0.82464	30°	0.81063
trans	15°	0.82814	30°	0.81586

Refractive index:

	cis				*trans*			
t°	Hα	D	Hβ	Hγ	Hα	D	Hβ	Hγ
15	1.42376	1.42703	1.43491	1.44162	1.43073	1.43396	1.44228	1.44949
20	1.42166	1.42473	1.43275	1.43949	—	—	—	—
30	1.41740	1.40050	1.42834	1.43492	1.42450	1.42753	1.43587	1.44290
$\frac{dn}{dt}$	0.00042	43	44	45	0.00042	43	43	44

HEXENE(5)NITRILES $CH_2{=}CH.(CH_2)_3.CN$

Constants: VANDEWYER (1935)

Boiling point: *cis:* 150°5; *trans:* 165°94

Density

cis	15°	0.82819	20°	0.82399	30°	0.81539
trans	15°	0.82910	20°	0.82470	30°	0.81604

Refractive index:

	cis				*trans*			
t°	Hα	D	Hβ	Hγ	Hα	D	Hβ	Hγ
15	1.43073	1.43321	1.44148	1.44802	1.43563	1.43884	1.44681	1.45354
20	1.42861	1.43128	1.43934	1.44585	1.43342	1.43659	1.44454	1.45122
30	1.42436	1.42703	1.43507	1.44150	1.42901	1.43213	1.43999	1.44659
$\frac{dn}{dt}$	0.00042	41	43	43	0.00044	45	45	46

HEPTENE(6)NITRILES $CH_2=CH.(CH_2)_4.CN$

Constants: de Hoffmann and Barbier (1935) *cis*
de Hoffman (1935) *trans*

Density

15°	0.82960	*cis*	30°	0.81754	*cis*
15°	0.83088	*trans*	30°	0.81875	*trans*

Refractive index

	cis				*trans*			
t°	Hα	D	Hβ	Hγ	Hα	D	Hβ	Hγ
15	1.43543	1.43849	1.44596	1.45226	1.43978	1.44292	1.45067	1.45719
30	1.42912	1.43205	1.43945	1.44555	1.43369	1.43668	1.44437	1.45082
$\frac{dn}{dt}$	0.00042	43	43	44	0.00041	42	42	42

OCTENE(7)NITRILE (*cis*) $CH_2=CH.(CH_2)_5.CN$

(with the lower boiling point)

Constants:

Density

t°	d		t°	d	
15	0.83236	Vandewyer (1935)	20	0.82854	Bruylants and Fonteyn (1933)
20	0.82842	„			
30	0.82062	„			

Refractive index

t°	Hα	D	Hβ	Hγ	
15	1.43991	1.44284	1.45029	1.45658	Vandewyer (1935)
20	1.43788	1.44079	1.44824	1.45453	„
30	1.43409	1.43693	1.44428	1.45047	„
$\frac{dn}{dt}$	0.00039	39	40	41	„
20	1.43749	1.44032	1.44777	—	Bruylants and Fonteyn (1933–34)

CITRACONITRILE (*cis*) and MESACONITRILE (*trans*)
$CN.C(CH_3)=CH.CN$

Constants: Van de Straete (1935)

	cis				*trans*			
	t°	p mm	t°	p mm	t°	p mm	t°	p mm
Saturated vapour pressure	122	11.5	172	86.5	66	10	117	102
	128	15	179.5	113	71	13	119.5	112
	150.5	41	189	160.5	88.5	32	124	181
	157.5	51.5	194	184	96.5	43.5	134	189
					100	52.5	138	227
					104	62.5		
Melting point	106°3–106°5				—			
Density	107°		1.1571		15°	0.98221	106°15	0.8941
	109°6		1.1560		30°	0.96797	116°1	0.8836
	115°25		1.1534					
Refractive index		110°7			15°	30°	$\frac{dn}{dt}$	110°7
	Hα	1.47975			1.46551	1.45941	0.00041	1.42169
	D	1.48420			1.46985	1.46367	41	1.42565
	Hβ	1.49571			1.48107	1.47453	43	1.43568

CYANOGEN or OXALONITRILE C_2N_2

Constants

Critical constants

t° cr.	p cr.	
126°55	58.2 atm.	Terwen (1916)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
C. −71.58	18.0	−51.80	100.6	−34.67	354.8	Terwen (1916)
−68.79	24.5	−49.31	122.4	−32.16	420.3	,,
−65.97	31.0	−46.82	147.9	−29.65	498.0	,,
−63.49	38.7	−43.98	182.9	−28.93	520.7	,,
−61.02	47.4	−42.18	208.0	−28.57	533.8	,,
−57.83	62.0	−39.68	248.6	−28.22	546.0	,,
−54.99	77.6	−37.18	297.7			,,

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
C. −93.16	1.7	−60.69	47.53	−35.28	336.4	Perry and Bardwell
−83.40	5.65	−49.02	123.2	−33.18	390.9	„ (1925)
−74.05	12.79	−42.83	196.7	−32.31	412.9	„
−69.24	22.29					„
L. −27.17	572.6	−14.84	1007.4	−9.60	1250.7	„
−25.19	629.8	−13.07	1086.4	−7.13	1387.4	„
−21.33	754.0	−11.28	1171.5	−7.12	1388.4	„
−17.75	886.4					„

t°	p atm.	t°	p atm.	t°	p atm.	
L. 1.40	2.54	62.15	15.75	87.7	28.10	Terwen (1916)
5.00	2.89	62.55	15.90	104.5	38.5	„
8.24	3.26	65.9	17.22	110.3	43.2	„
9.97	3.46	69.6	18.72	117.45	49.3	„
11.12	3.58	69.9	18.82	120.05	51.5	„
42.10	9.64	70.6	19.28	123.45	54.7	„
43.8	9.85	75.5	21.35	125.4	56.8	„
49.5	11.51	77.0	22.19	125.6	57.15	„
51.8	12.17	78.15	22.75	126.2	57.6	„
58.25	14.30	79.75	23.53	126.3	57.9	„
59.7	14.79	84.25	26.09			„

Boiling point | *Freezing point*

−21°15	Perry and Bardwell (1925)	*Form I*	−27°92	Terwen (1916)
−21°35	Terwen (1916)	*Form II*	−27°05	„

METHYLENE DICYANIDE or MALONITRILE $CN.CH_2.CN$

Constants

Melting point: 31°65 Van de Vloed (1938)

Density | *Viscosity*

t°	d		t°	$\eta \cdot 10^5$	
32.7	1.0506	Walden and Swinne	32.68	2850	Walden and Swinne
50.0	1.0338	„ (1912)	50.0	2150	„ (1912)
70.0	1.0149	„			
107.0	1.0794	„			
35.0	1.04873	Van de Vloed (1938)			

ETHYLENE DICYANIDE or SUCCINONITRILE $CN.CH_2.CH_2.CN$

Purified by fractional distillation under reduced pressure in the presence of P_2O_5. The criterion of purity is the constancy of the freezing point and the density for successive fractions.

Constants: B.E. (1937)

Melting point

56°6	MEERMAN (1943)	57°15	VAN DE VLOED (1938)
56°9	DEFFET (1940)	57°15–57°20	B.E. (1937)

Melting curve

t°	p kg/cm²		t°	p kg/cm²	
56.9	1	DEFFET (1940)	70.0	666	DEFFET (1940)
64.0	364	,,	75.0	921	,,
67.0	516	,,			

Density

Dilatometre		*Picnometre*		
t°	d	t°	d	
60	0.98669	60	0.98680	B.E. (1937)
70	0.97860			,,
80	0.97059			,,

Viscosity

t°	$\eta \cdot 10^5$	
60	2591	
75	2008	

Surface tension

t°	γ	
60	46.78	
70	45.72	
80	44.62	

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.
60	1.41496	1.41525	1.41734	1.41751	1.42170	1.42267	1.42590
$\frac{dn}{dt}$	0.00038	37	—	37	38	39	38

TRIMETHYLENE DICYANIDE or GLUTARONITRILE
$CN\,.\,CH_2\,.\,CH_2\,.\,CH_2\,.\,CN$

Constants: Serwy (1933)

Freezing point

Form α	−29°45	Timmermans (passim)	*Form β*	−32°4	Van de Vloed (1938)

Density

t°	d	
0	1.00293	Serwy (1933)
15	0.99112	„
30	0.9730	„
0	1.00291	Van de Vloed (1938)

Viscosity

t°	$\eta \cdot 10^5$	
15	8104	Serwy (1933)
30	5226	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.43426	1.43461	1.43699	1.44137	1.44242	1.44573	1.45048
$\frac{dn}{dt}$	0.00035	35	35	35	35	36	34

PENTAMETHYLENE DICYANIDE or PIMELONITRILE $CN.(CH_2)_5.CN$

Constants: Serwy (1933)

Freezing point: −31°4

Density

t°	d	
0	0.96181	
15	0.95070	
30	0.93961	

Viscosity

t°	$\eta \cdot 10^5$	
15	9080	
30	5501	

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	Hγ
15	1.44010	1.44044	1.44278	1.44721	1.44816	1.45167	1.45721
$\frac{dn}{dt}$	0.00030	30	30	30	29	31	32

ETHYL *iso*-CYANIDE or ETHYLCARBYLAMINE $CH_3.CH_2.NC$: Lowry and Henderson (1932) give a series of the refractive index.

10. NITROGEN DERIVATIVES of the CYCLIC SERIES

A. AROMATIC AMINES

The purity of these amines may be ascertained by transformation into an acetyl derivative of which the melting point is determined.

The velocity of crystallization is a very sensitive criterion of purity. This applies to all aromatic amines; the velocity is much reduced for impure colored samples.

ANILINE $C_6H_5NH_2$

Constants: B.E. (1935). — **Polyphasic equilibria**

Velocity of crystallization: −9°2 11.5 cm/min. Michel (1938)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
102.80	50.90	119.10	96.31	131.60	152.95	Garrick (1927)
108.40	63.44	122.52	110.57	134.10	166.70	„
108.80	64.41	123.82	115.59	135.10	172.69	„
114.50	81.05	124.80	118.52	141.50	214.30	„
115.65	84.94	126.00	124.47	147.90	264.52	„
77.4	16.2	144.45	237.8	171.8	544.1	Ramsay and Young
85.8	24.1	147.2	260.6	174.95	592.7	„ (1885)
93.0	33.6	147.55	263.6	176.1	612.1	„
99.0	43.8	150.15	286.0	177.8	638.8	„
105.1	56.5	152.5	307.0	178.1	646.2	„
124.5	118.8	155.05	333.3	180.55	690.7	„
128.45	137.1	157.2	355.5	181.15	701.5	„
129.95	145.25	162.15	411.9	182.1	719.8	„
132.15	156.2	165.4	452.9	184.3	762.2	„
134.6	169.9	168.65	497.1	184.45	763.6	„
141.9	219.4					„

Boiling point

184°35	$\frac{dt}{dp}$ *(10 mm):*	0°51	Lecat
184°40	„	0°51	B.E. (1935)
184°40	„	0°52	Ramsay and Young (1887)
184°4	„	0°53	Griffiths (1891)
	„	0°49	Harlow (1912)

Freezing point

−5°95	Atkins and Wallace (1913)	−6°05	Lang (1928)
−5°96	Ampola and Rimatori (1897)	−6°1	Linard (1925)
−5°98	Applebey and Davies (1925)	−6°10	B.E. (1935) and Deffet (1935)

Melting curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²
−6.10	1	10.00	841
0.00	317	13.00	996
5.50	598		

Critical solution point in C_6H_{12}: 30°95 Schlegel (1934)
31°0 Dessart (1926)
31°0 B.E. (1935)

Constants of state

Density

t°	d		t°	d	
0	1.03905	B.E. (1935)	0	1.0390	Bramley (1916)
15	1.02613	„	9.9	1.0303	„
30	1.01317	„	20	1.0219	„
			20.2	1.0214	„
0	1.03893	Dan Tyrer (1914)	29.6	1.0134	„
0	1.03894	Wiebe (1894)	30	1.0131	„
20	1.0217	Knops (1888)	40	1.0045	„
20	1.0217	Biron, Nikitine and Jakobson (1913)	60	0.9872	„
			80	0.9700	„
20	1.0218	Tsakalotos (1909)	125	0.9288	„
20	1.0219	Busse (1924)			
20	1.0220	Weegmann (1888)	25	1.01739	Gibson and Loeffler (1939)
20	1.02173	Dreisbach and Martin (1949)			
25	1.01750		25	1.0174	Few and Smith (1949)
			25	1.01749	Martin and Collie (1932)
25	1.0173	Walden and Andrieth (1933)	25	1.0176	Angelescu and Eustatiu (1936)
25	1.0173	Smith, Foecking and Barber (1949)	35	1.0088	Biron, Nikitine and Jakobson (1913)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	5299	B.E. (1935)	30	3145	Bramley (1916)
30	3176	„	40	2405	„
25	3640	Sachanow (1913)	60	1540	„
			80	1100	„
			125	637	„

Surface tension

t°	γ		t°	γ	
7.30	44.72	Bodson (1937)	47.5	40.40	Bodson (1937)
19.0	43.38	„	82.0	36.60	„
32.0	42.01	„	25	42.79	Angelescu and Eustatiu (1936)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.58079	1.58179	1.58872	1.58898	1.60333	1.60686	1.61854	—	B.E. (1935)
$\frac{dn}{dt}$	0.00051	51	—	52	54	55	55	—	„
20	—	—	—	1.58635	1.60060	—	1.61559	—	Feussner (1927)
$\frac{dn}{dt}$	—	—	—	513	527	—	546	—	„
20	—	1.57926	1.58632	—	—	1.60411	—	1.62036	Weegmann (1888)
20	—	1.57904	—	—	—	1.60380	—	1.62023	Knops (1888)
25	—	1.57662	—	—	—	—	—	—	Martin and Collie (1932)
25	—	—	1.5840	—	—	—	—	—	Smith, Foecking and Barber (1949)

Heat constants

Specific heat

t°	c_p	t°	c_p	t°	c_p	
30	0.500	70	0.532	113.8	0.564	Blacet, Leighton and Bartlett (1931)
35	0.503	75	0.533	118.9	0.575	
40	0.507	80	0.535	124.0	0.581	„
45	0.512	85	0.536	129.2	0.601	„
50	0.515	90	0.538	134.4	0.627	„
55	0.520	95	0.545	139.6	0.665	„
60	0.526	104.8	0.552			„
65	0.528	108.8	0.559			
20.08	0.4951	30.05	0.4981	40.07	0.5019	Ferguson and Miller
26.45	0.4969	35.63	0.5000	46.82	0.5054	„ (1933)
1.08	0.4778	15.00	0.4945	35.71	0.5006	Lang (1928)
2.21	0.4876	26.06	0.4971	43.09	0.5030	
4.18	0.4895	31.29	0.4983	49.42	0.5091	
		35.00	0.5006	58.87	0.5131	

METHYLANILINE $C_6H_5NH.CH_3$

Constants: B.E. (1935)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
66.7	5	92.6	20	107.6	40	Kahlbaum (1897)
79.2	10	97.2	25	112.5	50	„
86.9	15	101.1	30	122.5	75	„

Boiling point: 196°25 $\frac{dt}{dp}$ *(10 mm):* 0°53 B.E. (1935) and Lecat

Density

t°	d	
0	1.00216	B.E. (1935)
15	0.99018	„
30	0.97822	„

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	2568	B.E. (1935)	25	2020	Mussell, Thole and Dunstan (1912)
30	1766	„			
			55	1084	Thole (1913)

Surface tension

t°	γ		t°	γ	
15	39.97	Bodson (1937)	60	36.19	Bodson (1937)
30	39.54	„	80	34.49	„

Refractive index

t°	Li	He r.	Hα	D	He y.	He g.	Tl	Hβ	He v.	Hγ	
15	—	1.56590	1.56676	1.57367	1.57392	1.58810	—	1.59181	1.60365	—	B.E. (1935)
$\frac{dn}{dt}$	—	0.00052	52	—	53	53	—	54	55	—	„
21.2	1.56227	—	1.56348	1.57021	—	—	1.57806	1.58823	—	1.60322	Brühl (1895)
25	—	—	—	1.5684	—	—	—	—	—	—	Puschin and Matavulj (1932)

DIMETHYLANILINE $C_6H_5\ N(CH_3)_2$

Constants: B.E. (1935)

Saturated vapour pressure

t°	p mm		t°	p mm	
61.6	5	Kahlbaum (1897)	183.3	574	Kurbatow (1903)
73.1	10	,,	184.9	600	,,
81.2	15	,,	188.15	650	,,
87.5	20	,,	191.1	700	,,
92.30	25	,,	193.8	750	,,
96.3	30	,,	194.5	763	,,
102.8	40	,,			
108.2	50	,,			
118.3	75	,,			

Boiling point *Freezing point*

194°05	$\frac{dt}{dp}$ *(10 mm):* 0°52 Lecat	2°40	Deffet (1935)
194°15	,, 0°53 B.E. (1935)	2°45	B.E. (1935)
194°3	,, 0°54 Kurbatow (1903)		

Melting curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²	
2.40	1	20.00	783	
10.00	322	25.00	998	
15.00	570			

Density

t°	d		t°	d	
0	0.97232	B.E. (1935)	21.3	0.9551	Falk (1909)
15	0.96012	,,	36.2	0.9429	,,
30	0.94804	,,	43.3	0.9371	,,
21.5	0.9549	Guye and Mallet (1902)	53.4	0.9289	,,
25	0.95185	Martin and Collie (1932)	55	0.9274	Thole (1913)
25	0.95196	Few and Smith (1949)			
25	0.95198	Le Fevre and Le Fevre (1936)			

Viscosity

t°	$\eta \cdot 10^5$	
15	1528	B.E. (1935)
30	1159	,,
30	1170	Puschin and Pinter (1929)
55	844	Thole (1913)

Surface tension

t°	γ	
20	36.60	Bodson (1937)
40	34.43	,,
60	32.33	,,
80	30.20	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.55309	1.55404	1.56083	1.56109	1.57531	1.57866	1.59063	—	B.E. (1935)
$\frac{dn}{dt}$	0.00049	48	—	50	51	50	—	—	,,
18.4	—	1.55250	1.55914	—	—	1.57710	—	1.59422	Falk (1909 (→ 73°4)
24.6	—	1.54959	1.55620	—	—	1.57396	—	1.59059	,,
27.1	—	1.54847	1.55502	—	—	1.57267	—	1.58954	,,
32.5	—	1.54570	1.55230	—	—	1.56989	—	1.58651	,,
$\frac{dn}{dt}$	—	0.000495	499	—	—	519	—	539	,,
16.5	—	—	1.5599	—	—	—	—	—	Puschin and Matavulj (1932)
25	—	1.54923	—	—	—	—	—	—	Martin and Collie (1932)

ETHYLANILINE $C_6H_5.NH.C_2H_5$

Constants

Saturated vapour pressure: Kahlbaum and Tesse (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	t°	p mm
49.0	1	85.6	11	98.7	21	107.5	31	114.3	41
57.8	2	87.2	12	99.7	22	108.3	32	114.9	42
63.9	3	88.8	13	100.7	23	109.0	33	115.5	43
68.5	4	90.3	14	101.6	24	109.7	34	116.0	44
72.0	5	91.7	15	102.5	25	110.4	35	116.5	45
74.8	6	93.0	16	103.4	26	111.1	36	117.1	46
77.4	7	94.2	17	104.3	27	111.8	37	117.6	47
79.8	8	95.4	18	105.1	28	112.4	38	118.2	48
81.0	9	96.5	19	105.9	29	113.0	39	118.7	49
83.8	10	97.6	20	106.7	30	113.6	40	119.1	50

Boiling point: 205°5 LECAT

Freezing point: −65°8 TIMMERMANS

Density

t°	d		t°	d	
0.0	0.9796	DUTOIT and FRIEDERICH (1900) (KAHLBAUM'S sample)	0	0.9793	RADICE (1899)
			20	0.9628	COWLEY and PARTINGTON (1933)
13.1	0.9686	„			
37.5	0.9484	„	20	0.96315	KAHLBAUM (1898)
54.1	0.9343	„			

Refractive index

t°	Hα	D	Hβ	Hγ	
20	1.54994	1.55593	1.57239	1.58761	KAHLBAUM (1898)
20	—	1.5559	—	—	COWLEY and PARTINGTON (1933)

DIETHYLANILINE $C_6H_5.N(C_2H_5)_2$

Constants

Saturated vapour pressure: KAHLBAUM and TESSE (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	t°	p mm
63.2	2	99.2	14	113.1	26	121.3	37	126.0	45
70.0	3	100.7	15	116.4	30	121.9	38	126.5	46
87.6	8	102.1	16	117.2	31	122.5	39	127.0	47
89.8	9	103.5	17	117.9	32	123.1	40	127.5	48
91.9	10	109.3	22	118.6	33	123.7	41	128.1	49
93.9	11	110.3	23	119.3	34	124.3	42	128.6	50
95.8	12	111.3	24	120.0	35	124.8	43		
97.5	13	112.2	25	120.6	36	125.4	44		

Boiling point

216°7	BRÜHL (1895)
217°05	LECAT
217°5	RICHARDS and MATTHEWS (1908)

Freezing point

Stable form	−21°3	TIMMERMANS
Unstable form	−34°4	„

Density

t°	d		t°	d	
0.0	0.9508	Dutoit and Friederich	20	0.93507	Kahlbaum and Arndt (1898)
10.8	0.9422	„ (1900)	20	0.9348	Brühl (1895)
36.1	0.9221	(Kahlbaum's sample)	22.3	0.9325	„
54.4	0.9070	„	20	0.93484	Kremann, Meingast and
0	0.9508	Radice (1899)			Gugl (1914)
0.0	0.9504	Drucker and Kassel	70	0.89469	„
76.5	0.8901	„ (1911)			

Viscosity

t°	$\eta \cdot 10^5$	
0	3838	Drucker and Kassel (1911)
76.5	783.0	„
11	3251	Kremann, Meingast and Gugl (1914)

Refractive index

t°	Li	Hα	D	Tl	Hβ	Hγ	
20	—	1.53612	1.54206	—	1.55815	1.57294	Kahlbaum and Arndt (1898)
22.3	1.53408	1.53509	1.54105	1.54796	—	1.57077	Brühl (1895)

o-TOLUIDINE o-$C_6H_4\,CH_3.NH_2$

Constants: B.E. (1935)

Saturated vapour pressure: I Kahlbaum (1898) and II Dreisbach and Shrader (1949)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	t°	p mm
I 46.2	1	86.3	13	96.9	22	105.0	32	111.1	42
61.4	3	87.7	14	98.8	24	106.3	34	112.2	44
65.7	4	89.0	15	99.6	25	107.0	35	112.7	45
69.3	5	90.3	16	100.5	26	107.6	36	113.2	46
74.9	7	91.5	17	101.3	27	108.9	38	113.7	47
79.4	9	92.7	18	102.1	28	109.5	39	114.2	48
81.4	10	93.8	19	102.8	29	110.0	40	114.6	49
83.1	11	94.9	20	104.3	31	110.6	41	115.1	50
84.8	12	95.9	21						
II 118.46	57.04	122.22	66.39	139.00	123.76	168.06	315.52	184.80	507.50

Boiling point

200°30	$\frac{dt}{dp}$ *(10 mm):* 0°5203 Dreisbach and Martin (1949)	
200°35	„ 0°54 Lecat	
200°40	„ 0°54 B.E. (1935)	

Freezing point

Stable form	−16°4	B.E. (1935)	−16°10	DEFFET (1935)
Metastable „	−24°4	„	−24°5	„
	−24°3	BASKOW (1913)		

Melting curve: DEFFET (1935)

Stable form		*Metastable form*	
t°	p kg/cm²	t°	p kg/cm²
−16.10	1	−24.5	1
−11.0	285	−15.0	500
− 5.0	610	−10.0	882
+ 0.10	876		

Critical solution point in n-C_6H_{14}: 20°5 B.E. (1935)

Density

t°	d		t°	d	
0	1.01531	B.E. (1935)	20	0.99885	BIRON and MORGOULEWA (1914)
15	1.00279	„			
30	0.99037	„	12	1.0053	KREMANN, MEINGAST and
0	1.0153	BINGHAM, VAN KLOOSTER and KLEINSPEHN (1920)	18	1.0003	„ GUGL (1914)
20	0.9988		21	0.9979	„
40	0.9823	„	26	0.9937	„
60	0.9656	„	42.6	0.9801	„
80	0.9489	„	54	0.9706	„
100	0,9313	„	64	0.9625	„
			65.5	0.9611	„
0	1.01524	WIEBE (1894)	70	0.95749	„
20	0.9986	BIRON and MORGOULEWA (1915)	77.4	0.9515	„
20	0.9986	RICHARDS and MATHEWS (1908)	35	0.9865	BIRON, NIKITINE and JAKOBSON (1913)
20	0.9986	BRÜHL (1895)	54.5	0.9700	HERZEN (1902)

Viscosity

t°	$\eta \cdot 10^5$	
15	5195	B.E. (1935)
30	3183	„

Surface tension

t°	γ		t°	γ	
15	40.59	Lek (1930)	20	40.10	Bodson (1937)
20	40.03	„	30	38.99	„
30	38.93	„	50	36.83	„
			80	33.52	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He γ.	
15	1.56762	1.56853	1.57512	1.58823	1.59146	1.60128	B.E. (1935)
$\frac{dn}{d}$	0.00046	47	48	48	49	49	„

m-TOLUIDINE $m\text{-}C_6H_4\ CH_3.NH_2$

Constants: B.E. (1935)

Saturated vapour pressure: Kahlbaum and Toennies (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	t°	p mm
58.9	2	88.5	12	99.4	21	107.9	31	114.7	42
64.8	3	90.0	13	100.4	22	108.6	32	115.3	43
69.3	4	91.4	14	101.3	23	109.3	33	115.8	44
72.8	5	92.7	15	102.2	24	110.6	35	116.3	45
76.0	6	94.0	16	103.1	25	111.2	36	116.8	46
78.8	7	95.2	17	103.9	26	112.5	38	117.3	47
83.3	9	96.3	18	104.8	27	113.1	39	117.8	48
85.3	10	97.4	19	105.6	28	113.6	40	118.2	49
87.0	11	98.5	20	107.1	30	114.2	41	118.7	50

Boiling point

203°1	$\frac{dt}{dp}$ *(10 mm):* 0°55 Lecat
203°40	„ 0°55 B.E. (1935)

Freezing point

−31°0	O'Connor (1924)
−31°25	B.E. (1935)

Density

t°	d		t°	d	
0	1.00515	B.E. (1935)	20	0.9888	Busse (1924)
15	0.99302	„	20	0.98912	Kahlbaum (1898)
30	0.98096	„			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	4418	B.E. (1935)	55	1513	Thole (1913)
30	2741	„			

Surface tension

t°	γ		t°	γ	
20	38.02	Bodson (1937)	60	34.54	Bodson (1937)
30	37.16	„	70	33.67	„
40	36.28	„	80	32.75	„
50	35.42	„			

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.56293	1.56384	1.57047	1.58346	1.58672	1.59729
$\frac{dn}{dt}$	0.00045	47	48	48	49	49

p-TOLUIDINE $p\text{-}C_6H_4\ CH_3.NH_2$

Constants: B.E. (1937)

Saturated vapour pressure: Kahlbaum and Toennies (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	t°	p mm
46.9	1	85.5	12	97.6	22	105.0	31	110.7	40
55.9	2	87.0	13	98.5	23	105.7	32	111.3	41
62.0	3	88.4	14	99.4	24	106.4	33	111.8	42
66.4	4	89.7	15	100.2	25	107.1	34	113.4	45
70.1	5	91.1	16	101.1	26	107.7	35	113.9	46
73.0	6	92.3	17	102.0	27	108.3	36	114.4	47
75.7	7	93.4	18	102.7	28	109.0	37	114.9	48
80.3	9	94.5	19	103.4	29	109.6	38	115.3	49
82.2	10	95.6	20	104.3	30	110.2	39	115.8	50
83.9	11	96.6	21						

Boiling point

200°55	$\frac{dt}{dp}$ *(10 mm):* 0°54 B.E. (1937) and Lecat

Freezing point

43°7	Turner and Pollard (1914)	43°73	Hulett (1899) N.B. (in the work, sometimes 43°73 and sometimes 43°90)
43°7	Cauwood and Turner (1915)		
		43°75	B.E. (1937) and Deffet (1935)

Melting curve: Deffet (1935)

t°	p kg/cm^2	t°	p kg/cm^2
43.75	1	60.00	683
50.00	269	65.00	890
55.00	476	67.00	973

Density

t°	d		t°	d	
45	0.96589	B.E. (1937)	44	0.9663	Turner and Pollard (1914)
50	0.96155	„	50	0.9612	Morgan and Stone (1913)
55	0.95766	„			
60	0.95384	„			

Viscosity

t°	$\eta \cdot 10^5$	
45	1945	B.E. (1937)
60	1425	„

Surface tension

t°	γ	
45	36.06	Bodson (1937) and B.E. (1937)
60	34.10	„ „
80	31.54	„ „

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
45	1.54653	1.54741	1.55370	1.56627	1.56974	1.57985
$\frac{dn}{d}$	0.00052	54	54	54	—	—

DIMETHYL-*o*-TOLUIDINE $o\text{-}C_6H_4\ CH_3.N(CH_3)_2$

Constants

Saturated vapour pressure: KAHLBAUM (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	t°	p mm
54.1	5	73.9	15	84.4	25	91.4	34	96.8	43
57.2	6	75.2	16	85.3	26	91.9	36	97.3	44
59.9	7	76.4	17	86.1	27	92.6	35	97.9	45
62.2	8	77.6	18	86.9	28	93.2	37	99.9	49
64.3	9	78.7	19	87.7	29	93.8	38	100.4	50
66.2	10	79.7	20	88.5	30	94.5	39	102.7	55
67.9	11	80.7	21	89.2	31	95.1	40	104.8	60
69.6	12	81.7	22	89.9	32	95.6	41	110.4	75
71.0	13	82.6	23	90.6	33	96.2	42	118.1	100
72.5	14	83.6	24						

Freezing point: −61°3 TIMMERMANS

Density *Viscosity*

t°	d		t°	$\eta \cdot 10^5$	
20	0.92859	KAHLBAUM (1898)	55°	881	THOLE (1913)
20	0.9286	BIRON and MORGOULEWA (1915			

Refractive index

t°	Hα	D	Hβ	
20	1.52123	1.52643	1.55201	KAHLBAUM (1898)

DIMETHYL-*p*-TOLUIDINE: $p\text{-}C_6H_4.CH_3.N(CH_3)_2$: *Saturated vapour pressure, density* and *refractive index:* KAHLBAUM (1898)

m-XYLIDINE: $m\text{-}C_6H_3.(CH_3)_2.NH_2$: *Boiling point, density* and *refractive index:* BRÜHL (1895).

DIPHENYLAMINE $(C_6H_5)_2\ NH$

Constants

Saturated vapour pressure: HEIN (1914)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
278	450.0	280	470.0	282	491.0	284	515.0
279	460.0	281	480.0	283	503.0	285	527.0

Freezing point

52°7	Böeseken (1912)	53°0	Hrynakowski and Smoczkiewiczowna (1937)
52°8	Lee and Warner (1933)	53°2	Puschin and Grebenschtchikow (1912)
52°85	Narbutt (1905)	53°5	Baskow (1920)
52°93	Campetti (1912–13)		

Melting curve: Puschin and Grebenschtchikow (1912–13)

t°	p kg/cm²	t°	p kg/cm²
53.2	1	85.35	1250
68.0	550	92.5	1550
72.9	750	96.65	1750
80.7	1050	103.5	2050

Density

t°	d		t°	d	
60	1.0547	Turner and Merry (1910)	53	1.0573	Turner and Pollard (1914)
75	1.0435	„	77	1.0418	Dutoit and Friederich (1900)
90	1.0326	„	61	1.0543	Bramley (1916)
105	1.0117	„	81	1.0377	„

Viscosity

t°	$\eta \cdot 10^5$	
61	4170	Bramley (1916)
81	2525	„

Surface tension

t°	γ		t°	γ	
60	39.23	Turner and Merry (1910)	90	36.23	Turner and Merry (1910)
75	37.77	„	105	34.66	„

TRIPHENYLAMINE: $(C_6H_5)_3N$: *Saturated vapour pressure, melting point, density* and *surface tension:* Foward, Bowden and Jones (1949)

Constants: Turner and Merry (1910)

	DIBENZYLAMINE $(C_6H_5CH_2)_2NH$		TRIBENZYLAMINE $(C_6H_5CH_2)_3N$	
Density	20°	1.0276	95°	0.9912
	30°	1.0199	105°	0.9856
	45°	1.0083	120°	0.9741
	60°	0.9963	135°	0.9682
	75°	0.9844		
Surface tension	20°	40.68	95°	33.34
	30°	39.61	105°	32.43
	45°	38.01	120°	30.97
	60°	36.40	135°	29.54
	75°	34.79		

PHENYLHYDRAZINE $C_6H_5NH.NH_2$

Constants

Melting point

19°	Puschin and Rikowski (1932)	19°6	Blanksma (1910)
19°35	Oddo (1915)		

Density

t°	d		t°	d	
20	1.0981	Brühl (1895)	20	1.0978	Turner and Merry (1910)
20.3	1.0978	„	30	1.0899	„
30	1.0902	Puschin and Pinter (1929)	45	1.0777	„
			60	1.0653	„

Viscosity *Surface tension*

t°	$\eta \cdot 10^5$		t°	γ	
30	10090	Puschin and Pinter (1929)	20	45.55	Turner and Merry (1910)
			30	44.31	„
50	4580	Thole, Mussell and Dunstan (1913)	45	42.27	„
			60	40.40	„

Refractive index

t°	He r.	Hα	D	Tl	Hβ	Hγ	
10.3	1.59993	1.60118	1.60813	1.61630	1.62673	1.64368	Brühl (1895)
16.5	—	—	1.6094	—	—	—	Puschin and Matavulj (1932)

METHYLPHENYLHYDRAZINE: $C_6H_5NH.NHCH_3$: *Boiling point, density* and *refractive index:* Brühl (1895).

B. AROMATIC NITRILES

BENZONITRILE C_6H_5CN

Constants: B.E. (1935)

Saturated vapour pressure: KAHLBAUM and WIRKNER (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
62.8	7.0	77.9	15.6	90.6	28.0	99.2	41.2
64.6	7.7	79.0	16.4	91.0	28.6	99.5	41.6
65.0	8.2	79.2	16.7	91.7	29.6	99.9	42.3
67.1	9.0	80.4	17.6	92.0	29.9	100.5	43.5
67.2	9.1	80.6	17.8	92.8	31.0	100.7	43.8
69.4	10.1	82.1	19.2	93.2	31.5	101.1	44.6
69.7	10.2	82.3	19.4	93.6	32.1	101.8	45.8
71.6	11.3	83.6	20.5	94.0	32.8	102.1	46.5
72.8	12.1	84.8	21.9	94.3	33.3	102.4	47.0
73.6	12.3	85.4	22.1	95.0	34.2	103.0	48.2
74.4	12.9	85.8	22.6	95.4	35.1	103.2	49.4
75.3	13.5	86.0	22.9	95.9	35.9	103.5	50.0
75.4	13.6	87.1	24.0	96.0	36.1	104.1	50.6
75.5	13.8	88.1	25.0	96.8	37.0	104.7	51.7
76.1	14.2	88.6	25.9	97.3	38.0	104.9	52.0
76.6	14.6	89.2	26.5	97.8	38.8	105.2	52.9
76.9	14.7	90.2	27.4	98.5	40.0	105.8	54.0
77.6	15.4						

Boiling point

190°89	LOUGUININE (1900)
191°10	$\frac{dt}{dp}$ *(10 mm):* 0°47 B.E. (1935) and LECAT

Freezing point: −13°2 DEFFET (1935)
−13°8 B.E. (1935)

Melting curve: DEFFET (1935)

t°	p kg/cm²	t°	p kg/cm²
−13.2	1	0.00	660
−10.0	160	5.00	910
− 5.0	408	6.00	961

Density

t°	d		t°	d	
0	1.02275	B.E. (1935)	8	1.0157	GUYE and BAUD (1901)
15	1.00948	,,	54.9	0.9726	,,
30	0.99628	,,	99.1	0.9388	,,
			152.4	0.8848	,,
0	1.0227	WALDEN (1908-09)	25	1.0006	SUGDEN (1933)
0	1.02279	TIMMERMANS (1910)	25	1.00088	LE FEVRE and LE FEVRE (1936)

Viscosity

t°	$\eta \cdot 10^5$	
15	1447	B.E. (1935)
30	1111	,,

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.52444	1.52526	1.53082	1.54180	1.54461	1.55326
$\frac{dn}{dt}$	0.00048	48	48	49	49	49

DIAZOBENZENEIMIDE or PHENYLAZOIMIDE: $C_6H_5-N=N\equiv N$: *Saturated vapour pressure, density* and *viscosity:* CAROTHERS (1923)

C. NITROGEN DERIVATIVES of the POLYMETHYLENES

Cyclo-PENTYLAMINE $C_5H_9NH_2$

Constants: LA BRUYERE (unp.)

Freezing point: −85°7

Density			*Viscosity*			*Surface tension*	
t°	d		t°	$\eta \cdot 10^5$		t°	γ
0	0.87843		15	12388		15	31.38
15	0.86449		30	9567		20	30.75
30	0.85047					30	29.50

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.44942	1.44978	1.45238	1.45738	1.45852	1.46221
$\frac{dn}{dt}$	0.00047	47	48	52	52	51

Cyclo-HEXYLAMINE: $C_6H_{11}NH_2$ and DI- *cyclo*-HEXYLAMINE: $(C_6H_{11})_2NH$: *Boiling* and *freezing points, density* and *refractive index*: Carswell and Morrill (1937) and Van de Vloed (1938-1939)

Cyclo-PENTYLCYANIDE: C_5H_9CN: *Boiling point, density* and *refractive index:* Roberts and Roberts (1946)

Cyclo-HEXYLCYANIDE $C_6H_{11}CN$

Constants: La Bruyere (unp.)

Freezing point: 12°04

Density *Viscosity* *Surface tension*

t°	d		t°	$\eta \cdot 10^5$		t°	γ
15	0.91736		15	3295		15	34.91
30	0.90498		30	2331		20	34.37
						30	33.29

Refractive index

t°	He r.	Hα	He y.	He g.	He v.	
15	1.45086	1.45111	1.45359	1.45804	1.46255	
$\frac{dn}{dt}$	0.00042	42	42	42	43	

D. HETEROCYCLIC DERIVATIVES

PYRIDINE C_5H_5N

Constants: B.E. (1937)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
49.09	66.6	84.29	280.0	103.38	524.0	Hieber and Woerner
54.33	85.2	85.53	300.4	103.97	533.8	„ (1934)
60.03	110.9	87.57	313.4	106.66	579.5	„
61.57	118.4	90.16	342.4	107.84	605.0	„
63.75	129.6	90.54	358.3	111.66	678.6	„
65.83	139.6	93.42	380.0	112.51	693.8	„
67.41	149.8	94.62	395.3	113.08	705.2	„
74.09	192.6	95.83	412.8	113.48	715.6	„
74.62	199.6	97.07	426.4	114.97	742.8	„
78.75	229.8	98.31	446.5	115.56	759.6	„
80.15	244.2	100.32	476.2			„
42.9	50	55.6	90	86.1	300	Riley and Bailey
46.7	60	58.0	100	94.6	400	„ (1930)
49.9	70	75.1	200	115.4	760	„
52.8	80					„

Boiling point

115°26	Hoffman and Van der Werf (1946)	115°50	Grimm and Patrick (1923)
115°37	Wagner and Zerner (1910)	115°50	B.E. (1937)
115°38	Udovenko and Ayrapetova (1947)	115°50	Timmermans (1910)
115°4	Riley and Bailey (1930)	115°5	Roschdestwensky, Pukirew and Maslowa (1935)
115°4	Lecat	115°58	Hieber and Woerner (1934)

$\frac{dt}{dp}$ *(10 mm)*: 0°43 B.E. (1937) and Lecat

Freezing point

−41°5	Hoffman and Van der Werf (1946)	−41°7	Hazlet and Morrow (1942)
−41°5	B.E. (1937)	−42°	Zawidzki (1906)
		−42°	Wagner and Zerner (1910)

Density

t°	d		t°	d	
−45.0	1.04882	Timmermans (1920)	0	1.00296	B.E. (1937)
−37.2	1.04059	„	15	0.98783	„
−35.3	1.03894	„	30	0.97281	„
−30.6	1.03385	„	0	1.00296	Ewert (1936)
−22.95	1.02606	„	25	0.9782	Roschdestwensky, Pukirew and Maslowa (1935)
−13.1	1.01621	„			
− 6.2	1.00926	„			
0	1.00303	„			
15	0.98800	„			
20	0.98300	„			
25	0.97806	„			
0	1.0031	Müller and Brenneis	50	0.9526	Müller and Brenneis
5	0.9982	„ (1932)	55	0.9474	„ (1932)
10	0.9935	„	60	0.9424	„
15	0.9877	„	65	0.9366	„
20	0.9826	„	70	0.9318	„
25	0.9778	„	75	0.9267	„
30	0.9729	„	80	0.9211	„
35	0.9677	„	85	0.9164	„
40	0.9629	„	90	0.9111	„
45	0.9575	„			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	1038	B.E. (1937)	30	829	DUTOIT and DUPERTHUIS
30	829	,,	40	724	,, (1908)
			50	639	,,
0	1360	DUTOIT and DUPERTHUIS	60	569	,,
10	1130	,, (1908)	70	508	,,
20	958	,,	80	462	,,

Surface tension

t°	γ	
15	37.86	B.E. (1937)
20	37.25	,,
30	35.70	,,

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.50718	1.50778	1.51246	1.51271	1.52221	1.52459	1.53205	B.E. (1937)
$\frac{dn}{dt}$	0.00051	51	—	52	54	54	54	,,
15	1.50718	1.50778	—	1.51273	1.52221	1.52430	1.53205	EWERT (1936)
$\frac{dn}{dt}$	0.00051	51	—	52	54	54	54	,,
18.7	—	—	1.5106	—	—	—	—	GRIMM (1929)
20	—	—	1.5100	—	—	—	—	,,
20	—	—	1.5102	—	—	—	—	ROSCHDESTWENSKY (1935), etc.

Specific heat: 17° 0.409 SWIETOSLAWSKI, RYBICKA and SOLODOZOWSKA (1931)

α-PICOLINE or 2-METHYLPYRIDINE α-$CH_3.C_5H_4$ N

Constants: FREISER and GLOWACKI (1948)

Saturated vapour pressure: RILEY and BAILEY (1930)

t°	p mm	t°	p mm	t°	p mm	t°	p mm	t°	p mm
128.8	760	98.6	300	70.6	100	65.1	80	56.8	60
107.0	400	88.8	200	68.0	90	61.8	70	53.3	50

Boiling point

128°8	Riley and Bailey (1930)	129°44	$\frac{dt}{dp}$ *(10 mm):* 0°46 Freiser and Glowacki(1948)
128°8	Constam and White (1903)		
129°0	Hoffman and Van der Werf (1946)		

Freezing point

−64°2	Hoffman and Van der Werf (1946)	−66°55	Freiser and Glowacki (1948)

Density

t°	d		t°	d	
20	0.94432_0	Freiser and Glowacki	60	0.90665_8	Freiser and Glowacki
30	0.93491_3	„ (1948)	70	0.89706_6	„ (1948)
40	0.92556_5	„	80	0.88722_2	„
50	0.91607_2	„	15	0.94972	Constam and White (1903)

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
0	1097.0	Freiser and Glowacki	50	562.1	Freiser and Glowacki
10	935.1	„ (1948)	60	505.4	„ (1948)
20	810.2	„	70	458.5	„
30	709.6	„	80	416.5	„
40	629.6	„			

Refractive index: Freiser and Glowacki (1948)

t°	D	λ:546.1	λ:435.8	t°	D	λ:546.1	λ:435.8
20	1.50105	1.50493	1.52170	30	1.49592	1.49982	1.51657

Iso-QUINOLINE C_9H_7N

Constants: Freiser and Glowacki (1949)

Boiling point	*Freezing point*
243°25 $\frac{dt}{dp}$ *(10 mm):* 0°59	26°48

Density

t°	d	t°	d
30	1.09101	100	1.03540
40	1.08309	125	1.01547
50	1.07519	150	0.99498
60	1.06731	175	0.97421
70	1.05945	200	0.95300
80	1.05143		

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$
30	3252.8	100	1023.0
40	2603.4	125	778.7
50	2132.3	150	621.7
60	1787.2	175	506.7
70	1526.9	200	422.3
80	1322.3		

Refractive index: $n_D^{30°}$: 1.62078

QUINOLINE C_9H_7N

Prepared by synthesis using the method described by SKRAUP modified by DARZENS, DELABY and HIRON (1930); a commercial sample could not be purified sufficiently by fractional distillation.

Constants: B.E. (1937). — **Polyphasic equilibria**

Saturated vapour pressure: YOUNG (1889)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
75.3	2.55	126.05	26.75	166.85	115.65	205.05	346.8
78.3	2.75	128.06	29.25	168.05	119.7	207.2	368.1
81.1	3.25	132.25	33.6	170.95	131.2	210.1	395.8
83.05	3.75	134.95	37.4	171.05	132.6	210.2	400.7
86.55	4.55	138.1	42.1	174.5	147.55	213.2	428.45
90.05	5.50	141.05	47.3	177.35	159.8	214.8	448.2
93.65	6.15	144.15	54.15	179.6	171.85	216.05	460.0
96.55	7.15	146.65	58.0	183.15	190.45	218.9	493.0
99.45	8.1	149.5	64.1	187.15	213.8	219.35	500.0
102.1	9.3	152.15	70.0	190.1	232.55	221.9	528.8
104.3	10.65	154.95	77.2	192.65	249.5	224.25	560.3
107.4	11.8	157.85	84.8	194.65	263.9	228.0	610.9
110.05	13.6	159.15	90.2	195.55	269.2	228.45	621.1
113.05	15.6	160.15	93.25	198.1	288.35	231.1	656.0
115.9	17.55	163.05	101.3	200.15	304.9	232.8	683.3
118.1	19.1	164.6	107.2	201.2	313.95	233.95	701.7
120.75	21.3	165.4	109.4	204.1	339.35	236.65	745.3
123.45	23.85						

Boiling point *Freezing point*

237°10	$\frac{dt}{dp}$ *(10 mm):* 0°57 B.E. (1937)	−15°6	B.E. (1937)
237°3	LECAT		,,
237°45	YOUNG (1889)		,,

Constants of state

Density

t°	d		t°	d	
0	1.10957	B.E. (1937)	15	1.0978	LUMSDEN (1907)
15	1.09771	,,	40	1.0785	,,
30	1.08579	,,	80	1.0478	,,
10	1.1021	GLADSTONE (1884)	120	1.0150	,,
20	1.09391	NASINI and CARRARA (1894)	160	0.9826	,,
			200	0.9489	,,
25	1.0900	WALDEN (1907)	220	0.9319	,,
31.1	1.08407	SCHWERS (1911)			
53	1.06725	,,			
73.5	1.05090	,,			

Viscosity

t°	$\eta \cdot 10^5$	
15	4354	B.E. (1937)
30	2997	,,

Surface tension

t°	γ	
20	45.62	B.E. (1937) and BODSON (1937)
30	44.82	,,

Refractive index

t°	Hα	D	He y.	He g.	Hβ	He v.	Hγ	
15	1.6212	1.62928	1.62954	1.64743	1.6522	1.66683	—	B.E. (1937)
$\frac{dn}{dt}$	—	—	0.00048	49	—	50	—	,,
20	1.61927	—	—	—	1.65033	—	1.68067	NASINI and CARRARA (1894)
25	—	1.62475	—	—	—	—	—	WALDEN (1907)

Heat constants

Specific heat: PARKS, TODD and MOORE (1936)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −183.16	0.1068	−123.16	0.1520	−73.16	0.1975	L. −13.16	0.3388
−173.16	0.1136	−113.16	0.1602	−63.16	0.2076	− 3.16	0.3466
−163.16	0.1209	−103.16	0.1688	−53.16	0.2185	+ 6.84	0.3544
−153.16	0.1283	− 93.16	0.1779	−43.16	0.234	16.84	0.3622
−143.16	0.1360	− 83.16	0.1876	−33.16	0.257	26.84	0.3701
−133.16	0.1440						

Heat of melting	19.98 cal 15°/g	PARKS, TODD and MOORE (1936)

QUINOXALINE: $C_8H_6N_2$ and QUINALDINE (2-Methylquinoline): $CH_3.C_9H_6N$: *Boiling* and *melting point, density* and *refractive index:* BRÜHL (1895).

TETRAHYDROQUINOLINE: $C_9H_{11}N$: *Boiling point, density* and *magnetic rotatory power:* PERKIN (1896).

CARBAZOLE: $C_{12}H_9N$: *Saturated vapour pressure:* the values given by SENSEMAN and NELSON (1923) and by MORTIMER and MURPHY (1923) do not agree.

PIPERIDINE $C_5H_{11}N$

Constants: B.E. (1937)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
35.84	50	48.34	90	78.54	300	RILEY and BAILEY
39.84	60	50.84	100	87.04	400	,, (1930)
42.84	70	67.64	200	106.34	760	,,
45.84	80					,,
19.50	22.8	23.93	29.1	30.00	40.2	EWERT (1937)
21.13	24.7	26.90	34.1	33.50	48.3	,,

Boiling point

106°32	WALLIS (1906)
106°40	$\frac{dt}{dp}$ *(10 mm):* 0°44 B.E. (1937)
106°4	,, 0°40 LECAT

Freezing point: —10°5 EWERT (1937)

Density

t°	d		t°	d	
0	0.87952	B.E. (1937)	25	0.8564	KURNAKOW and SHEMTSHUSHNY
15	0.86591	,,	50	0.8336	,, (1913)
30	0.85215	,,	80	0.8033	,,
0	0.87952	EWERT (1937)			

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
15	1679	B.E. (1937)	25	1362	KURNAKOW and SHEMTSCHUSHNY
30	1224	„	50	845	„ (1913)
20	1486	TSAKALOTOS (1909)	80	738	„
25	1370	THOLE (1914)			

Surface tension

t°	γ	
15	30.64	B.E. (1937)
20	30.05	„
30	28.81	„

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	
15	1.45216	1.45248	1.45532	1.46037	1.46174	1.46563	B.E. (1937)
$\frac{dn}{dt}$	0.00048	47	48	48	49	49	„
15	1.45214	—	1.45530	1.46035	—	1.46556	EWERT (1937)

NICOTINE $C_5H_4N.C_4H_7N(CH_3)$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
61.1	0.62	133.8	28.4	194.8	220.1	YOUNG and NELSON
61.4	0.57	140.1	37.4	198.9	248.0	„ (1929)
99.4	5.91	146.9	48.3	199.9	254.0	„
99.7	5.97	155.0	64.7	212.3	343.0	„
102.3	7.0	161.0	83.7	218.9	406.7	„
106.9	9.0	170.0	104.1	225.1	473.3	„
112.9	12.0	178.4	137.5	229.4	530.5	„
116.7	14.9	184.5	164.3	236.1	623.2	„
124.5	19.4	189.3	186.4	246.2	763.0	„
25	0.0425	125	17	—	—	NORTON, BIGELOW and VINCENT (1940)

Density

t°	d		t°	d	
20	1.0093	Lowry and Singh (1925)	20	1.00925	Jephcott (1919)
20	1.0091	Tsakalotos (1909)	60	0.97799	„
20	1.00924	Ratz (1905)	80	0.96184	„
			97.7	0.94534	„

Viscosity: $\eta \cdot 10^5$: 20° 4536 Tsakalotos (1909)

Refractive index: Gifford and Lowry (1927)

λ	15°	λ	15°	λ	15°	λ	15°
7685	1.520616	5893	1.529390	5270	1.535148	4471	1.546995
7065	1.522949	5608	1.531779	4861	1.540359	4413	1.548080
6708	1.524527	5461	1.532914	4678	1.543175	4341	1.549354
6503	1.525260						

Rotatory power

$[\alpha]^{5461}_{20°}$	$-205°58$	Lowry and Lloyd (1929) (see original work)
$[\alpha]^{5461}_{20°}$	$-205°$	Gifford and Lowry (1927)
$[\alpha]^{D}_{20°}$	$-169°22$ and	Ratz (1905)
$[\alpha]^{D}_{20°}$	$-169°54$	„
$[\alpha]^{D}_{20°}$	$-168°90$	Norton, Bigelow and Vincent (1940)

ANABASINE (nicotine isomer): $C_{10}H_{14}N_2$: *Saturated vapour pressure, density, refractive index* and *rotatory power:* Nelson (1934).

11. OXY-NITROGEN DERIVATIVES

A. ALIPHATIC NITRO DERIVATIVES

NITROMETHANE CH_3NO_2

Constants: B.E. (1932)

Saturated vapour pressure

t°	p mm		t°	p mm	
15.1	21.9	Joukovsky (1934)	60	176.0	Halban (1913)
18.0	25.2	„	70	262.5	„
20.5	28.8	„	80	375.0	„
25.3	37.1	„	85	450.0	„
30.0	47.6	„	90	531.5	„
			95	623.5	„
			100	744.5	„

Boiling point

101°0	Smyth and Mac Alpine (1934)	101°22	$\frac{dt}{dp}$ *(10 mm):* 0°45 Lecat
101°2	Walden (1903)	101°25	„ 0°44 B.E. (1932)

Freezing point: —28°6

Critical solution point in CS_2*:* 63°3

Density

t°	d		t°	d	
0	1.16490	B.E. (1932)	25	1.1311	Groves and Sugden (1937)
15	1.14476	„	25	1.1312	Wright, Murray-Rust and Hartley (1931)
30	1.12453	„			

Viscosity

t°	$\eta \cdot 10^5$	
15	694	B.E. (1932)
30	595	„
25	627	Wright, Murray-Rust and Hartley (1931)

Surface tension

t°	γ	
15	37.74	B.E. (1932)
20	36.98	„
30	35.51	„
20	36.82	Harkins, Clark and Roberts (1920)

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.38090	1.38139	—	1.38411	1.38911	1.39058	1.39462	B.E. (1932)
$\frac{dn}{dt}$	0.00041	42	—	42	42	43	43	„
16	—	—	—	1.38386	—	—	—	Joukovsky (1934)
20	—	—	1.38195	—	—	—	—	Smyth and Mac Alpine (1934)

TETRANITROMETHANE: $C(NO_2)_4$: *Feezing point, density* and *refractive index:* Nicholson (1949).

1-NITRO-*n*-PENTANE: $C_5H_{11}NO_2$ and 1-NITRO-*iso*-PENTANE: $(CH_3)_2CH.(CH_2)_2NO_2$: *Boiling point, density* and *viscosity:* Friend and Hargreaves (1943).

ETHYL NITRITE: $C_2H_5NO_2$ and *n*-PROPYL NITRITE. *n*-$C_3H_7NO_2$: *Boiling point, density* and *viscosity:* Friend and Hargreaves (1943); *boiling point:* Lecat

ETHYLENE GLYCOL DINITRATE $(CH_2NO_3)_2$

Constants

Saturated vapour pressure

t°	p mm		t°	p mm	
0	0.0044	Marshall (1930)	60	1.3	Marshall (1930)
20	0.038	„	80	5.9	„
40	0.26	„	100	22.0	„

Freezing point: −22°3 Rinkenbach (1927)

Density

t°	d		t°	d	
4	1.5099	Perkin (1889)	20	1.4882	Perkin (1889)
10	1.5012	,,	25	1.4817	,,
15	1.4947	,,	15	1.4943	Peterson (1930)

Viscosity

t°	$\eta \cdot 10^4$		t°	$\eta \cdot 10^4$	
10.0	573	Peterson (1930)	40.0	260	Peterson (1930)
15.0	487	,,	45.0	236	,,
20.0	421	,,	50.0	214	,,
25.0	369	,,	55.0	195	,,
30.0	329	,,	60.0	182	,,
35.0	292	,,			

Refractive index

t°	n_D		t°	n_D	
15.0	1.4491	Rinkenbach (1927)	20.0	1.4472	Rinkenbach (1927)
25.0	1.4454	,,	30.0	1.4435	,,

DIETHYLENE GLYCOL DINITRATE $(NO_3\,CH_2.CH_2)_2\,O$

Constants: Rinkenbach (1927)

Saturated vapour pressure: 22°4 0.007 mm

Freezing point: −11°3

Density

t°	d		t°	d	
0.0	1.4090	Rinkenbach (1927)	20.0	1.3831	Rinkenbach (1927)
5.0	1.4030	,,	25.0	1.3745	,,
10.0	1.3965	,,	30.0	1.3664	,,
15.0	1.3896	,,	15.0	1.3889	Peterson (1930) (sic.)

Viscosity

t°	$\eta \cdot 10^4$		t°	$\eta \cdot 10^4$	
10	1190	Peterson (1930)	40	437	Peterson (1930)
15	970	„	45	383	„
20	808	„	50	351	„
25	673	„	55	306	„
30	573	„	60	275	„
35	496	„			

Refractive index

t°	n_D		t°	n_D	
0.0	1.4593	Rinkenbach (1927)	20.0	1.4517	Rinkenbach (1927)
5.0	1.4574	„	25.0	1.4498	„
10.0	1.4555	„	30.0	1.4479	„
15.0	1.4536	„	35.0	1.4460	„

PROPYLENE GLYCOL DINITRATE

$CH_3.CHNO_3.CH_2NO_3$

Constants: Peterson (1930)

Density: 15° 1.3927

TRIMETHYLENE GLYCOL DINITRATE

$NO_3CH_2.CH_2.CH_2NO_3$

Density: 15° 1.4695

Viscosity

t°	$\eta \cdot 10^4$	t°	$\eta \cdot 10^4$	t°	$\eta \cdot 10^4$	t°	$\eta \cdot 10^4$
10	556	40	246	10	851	40	344
15	476	45	221	15	706	45	310
20	407	50	203	20	597	50	282
25	355	55	183	25	501	55	258
30	314	60	171	30	436	60	233
35	278			35	388		

GLYCERYL TRINITRATE or NITROGLYCERIN $CH_2NO_3.CHNO_3.CH_2NO_3$

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
20.0	0.00025	50.0	0.0072	80.0	0.096	Marshall and Peace (1916)
30.0	0.00083	60.0	0.0188	90.0	0.230	„
40.0	0.0024	70.0	0.043	93.4	0.30	„
20	0.00024					Chiaraviglio and Carbino (1916)

Freezing point

Labile form	1°9	*Stable form*	13°0	Hackel (1936)
„	2°0	„	13°1	Hibbert (1912–14)
„	2°1	„	13°2	Kast (1906)

Density

t°	d		t°	d	
4	1.6144	Perkin (1889)	20	1.5939	Perkin (1889)
10	1.6064	„	25	1.5862	„
15	1.5995	„	15	1.5964	Peterson (1930)

Viscosity

t°	$\eta \cdot 10^3$		t°	$\eta \cdot 10^3$	
10	692	Peterson (1930)	40	136	Peterson (1930)
15	491	„	45	112	„
20	360	„	50	93.8	„
25	270	„	55	79.2	„
30	210	„	60	68.0	„
35	168	„			

Surface tension: 20° 51.1 Sutton and Harden (1934)

Heat of combustion	20° (c_v) 1615 cal 15°/g	Taylor and Halle (1947)
	„ (c_p) 1603 „	„

B. ALIPHATIC AMIDES

FORMAMIDE $H.CONH_2$

This product is purified by distillation at reduced pressure and by fractional fusion.

Constants: B.E. (1935):

Freezing point

2°55	Smith (1931)	2°55	Smith (1940)
2°55	B.E. (1935) and Deffet (1935)		

Melting curve

t°	p kg/cm²		t°	p kg/cm²	
2.55	1	Deffet (1935)	10.00	820	Deffet (1935)
5.00	270	„	12.50	1085	„
7.50	540	„			

Density *Viscosity* *Surface tension*

t°	d	t°	$\eta \cdot 10^5$	t°	γ	
15	1.13756	15	4320	—	—	B.E. (1935)
20	1.13340	30	2926	—	—	„
30	1.12483					„
18	1.13510	18	3970	18	58.53	Smith (1931)
20	1.13339	20	3764	20	58.35	„
25	1.12918	25	3302	25	57.91	„
35	1.12068			35	57.11	„
				50	55.72	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.44052	1.44565	1.44911	1.44928	1.45574	1.45754	1.46253	B.E. (1935)
$\frac{dn}{dt}$	0.00032	32	—	32	32	33	35	„
20	—	—	1.44754	—	—	—	—	Smith (1940)
110	1.4134	—	1.4170	1.4171	1.4230	—	1.4291	Bruylants (1939)
130	1.4060	—	1.4095	1.4096	1.4155	—	1.4213	„

Smith (1940) gives a series of values for other wave-lengths.

ACETAMIDE $CH_3.CONH_2$ | PROPIONAMIDE $CH_3.CH_2.CONH_2$

Constants

		ACETAMIDE $CH_3.CONH_2$		PROPIONAMIDE $CH_3.CH_2.CONH_2$		
Boiling point		221°15		222°2		LECAT
Density		—		110°	0.9262	BRUYLANTS (1939)
		—		130°	0.9093	,,
Refractive index		110°	130°	110°	130°	
	He r.	1.4126	1.4048	1.4130	1.4053	BRUYLANTS (1932)
	D	1.4158	1.4079	1.4160	1.4082	,,
	He y.	1.4159	1.4080	1.4161	1.4083	,,
	He g.	1.4214	1.4132	1.4211	1.4132	,,
	He v.	1.4268	1.4185	1.4261	1.4180	,,

CARBAMIDE or UREA $CO(NH_2)_2$

Constants

Melting point

132°65	SHNIDMAN and SUNIER (1932)
132°7	SPEYERS (1896)
132°8	HRYNAKOWSKI and SMOCZKIEWIECZOWNA (1937)

Specific heat: RUEHRWEIN and HUFFMAN (1946) (M.W. 60.058)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
−253.71	0.01896	−209.68	0.1189	−120.73	0.2170	−6.72	0.3363
−252.63	0.02141	−205.89	0.1247	−109.81	0.2283	−4.50	0.3389
−251.07	0.02546	−200.95	0.1316	− 99.35	0.2393	−0.62	0.3437
−247.91	0.03373	−194.98	0.1396	− 89.29	0.2499	+0.84	0.3449
−243.60	0.04527	−189.39	0.1470	− 79.59	0.2600	3.23	0.3472
−239.80	0.05535	−185.24	0.1516	− 70.21	0.2698	8.26	0.3523
−236.34	0.06424	−184.10	0.1530	− 62.66	0.2780	8.90	0.3533
−232.48	0.07349	−180.14	0.1577	− 55.41	0.2852	15.56	0.3600
−228.59	0.08242	−173.82	0.1636	− 46.78	0.2938	16.36	0.3614
−224.64	0.09119	−166.37	0.1710	− 38.35	0.3025	23.67	0.3692
−220.57	0.09917	−159.27	0.1781	− 30.12	0.3111	30.86	0.3771
−217.19	0.1057	−151.85	0.1856	− 24.19	0.3177	37.91	0.3844
−216.44	0.1070	−143.06	0.1943	− 22.07	0.3196	44.85	0.3920
−213.74	0.1119	−132.21	0.2055				

SATURATED and UNSATURATED AMIDES

Refractive index $R.CH_2.CH_2.CONH_2$

	t°	He r.	D	He y.	He g.	He v.	He r.	D
$R=CH_3$	110	1.4135	1.4165	1.4167	1.4217	1.4264	1.4564	1.4610
	116	—	—	—	—	—	1.4539	1.4584
	120	1.4097	1.4116	1.4127	1.4176	1.4223	—	—
	130	1.4059	1.4087	1.4087	1.4135	1.4182	1.4481	1.4525
	165	—	—	—	—	—	—	—
$R=C_2H_5$	90	—	—	—	—	—	1.4581	1.4624
	110	1.4155	1.4183	1.4184	1.4232	1.4279	1.4499	1.4542
	130	1.4077	1.4104	1.4104	1.4152	1.4199	—	—
	155	—	—	—	—	—	—	—
$R=n\text{-}C_3H_7$	90	—	—	—	—	—	1.4552	1.4592
	110	1.4172	1.4200	1.4200	1.4248	1.4294	1.4470	1.4510
	130	1.4096	1.4123	1.4124	1.4171	1.4217	—	—
	140	—	—	—	—	—	—	—
$R=n\text{-}C_4H_9$	90	—	—	—	—	—	1.4529	1.4569
	110	1.4190	1.4217	1.4218	1.4265	1.4310	1.4444	1.4483
	130	1.4115	1.4142	1.4142	1.4188	1.4233	—	—
	140	—	—	—	—	—	—	—
$R=n\text{-}C_5H_{11}$	90	—	—	—	—	—	1.4515	1.4554
	110	1.4205	1.4232	1.4234	1.4281	1.4326	1.4433	1.4470
	130	1.4133	1.4160	1.4161	1.4207	1.4251	—	—
	140	—	—	—	—	—	—	—
$R=n\text{-}C_6H_{13}$	90	—	—	—	—	—	1.4506	1.4543
	110	1.4221	1.4248	1.4249	1.4295	1.4340	1.4426	1.4461
	130	1.4147	1.4174	1.4175	1.4220	1.4264	—	—
	140	—	—	—	—	—	—	—
$R=n\text{-}C_7H_{15}$	90	—	—	—	—	—	1.4499	1.4535
	110	1.4234	1.4261	1.4262	1.4308	1.4355	1.4420	1.4455
	130	1.4162	1.4188	1.4189	1.4234	1.4278	—	—
	140	—	—	—	—	—	—	—
$R=n\text{-}C_8H_{17}$	90	—	—	—	—	—	1.4493	1.4528
	110	1.4246	1.4272	1.4273	1.4319	1.4364	1.4415	1.4450
	130	1.4172	1.4198	1.4199	1.4244	1.4288	—	—
	140	—	—	—	—	—	—	—
$R=n\text{-}C_9H_{19}$	110	1.4259	1.4287	1.4288	1.4333	1.4378	—	—
	130	1.4188	1.4214	1.4215	1.4260	1.4304	—	—

Constants: Bruylants (1939)

$RCH{=}CH.CONH_2$ *Refractive index*

Cis			*Trans*						
He y.	He g.	He v.	He r.	D	He y.	He g.	He v.	t°	
1.4612	1.4690	1.4770	—	—	—	—	—	110	$R{=}CH_3$
1.4586	1.4664	1.4744	—	—	—	—	—	116	
—	—	—	—	—	—	—	—	120	
1.4526	1.4604	1.4683	—	—	—	—	—	130	
—	—	—	1.4375	1.4420	1.4421	1.4499	1.4578	165	
1.4626	1.4702	1.4780	—	—	—	—	—	90	$R{=}C_2H_5$
1.4542	1.4617	1.4692	—	—	—	—	—	110	
—	—	—	—	—	—	—	—	130	
—	—	—	1.4377	1.4418	1.4419	1.4493	1.4579	155	
1.4594	1.4666	1.4739	—	—	—	—	—	90	$R{=}n\text{-}C_3H_7$
1.4511	1.4582	1.4652	—	—	—	—	—	110	
—	—	—	1.4437	1.4478	1.4479	1.4551	1.4624	130	
—	—	—	1.4400	1.4440	1.4441	1.4512	1.4585	140	
1.4570	1.4639	1.4708	—	—	—	—	—	90	$R{=}n\text{-}C_4H_9$
1.4484	1.4552	1.4620	—	—	—	—	—	110	
—	—	—	1.4415	1.4454	1.4455	1.4525	1.4594	130	
—	—	—	1.4375	1.4414	1.4415	1.4483	1.4553	140	
1.4555	1.4620	1.4687	—	—	—	—	—	90	$R{=}n\text{-}C_5H_{11}$
1.4471	1.4535	1.4599	—	—	—	—	—	110	
—	—	—	—	—	—	—	—	130	
—	—	—	1.4362	1.4400	1.4401	1.4466	1.4531	140	
1.4544	1.4609	1.4673	—	—	—	—	—	90	$R{=}n\text{-}C_6H_{13}$
1.4462	1.4525	1.4589	—	—	—	—	—	110	
—	—	—	—	—	—	—	—	130	
—	—	—	1.4352	1.4387	1.4387	1.4451	1.4514	140	
1.4535	1.4598	1.4661	—	—	—	—	—	90	$R{=}n\text{-}C_7H_{15}$
1.4456	1.4517	1.4579	—	—	—	—	—	110	
—	—	—	1.4384	1.4419	1.4419	1.4482	1.4544	130	
—	—	—	1.4342	1.4377	1.4378	1.4439	1.4501	140	
1.4529	1.4590	1.4652	—	—	—	—	—	90	$R{=}n\text{-}C_8H_{17}$
1.4451	1.4510	1.4570	—	—	—	—	—	110	
—	—	—	1.4371	1.4405	1.4406	1.4466	1.4527	130	
—	—	—	1.4336	1.4370	1.4370	1.4431	1.4491	140	
—	—	—	—	—	—	—	—	110	$R{=}n\text{-}C_9H_{19}$
—	—	—	—	—	—	—	—	130	

Sublimation pressure

	$R.CH_2.CH_2.CONH_2$		$R.CH{=}CH.CONH_2$			
			Cis		*Trans*	
	t°	p mm	t°	p mm	t°	p mm
$R{=}CH_3$	70.00	0.52	50.05	0.59	90.00	0.53
	80.00	0.95	60.00	0.73	99.95	1.27
	90.00	2.10	70.05	0.94	109.90	2.41
	99.95	4.28	79.95	1.42	120.05	4.08
	110.05	8.15	90.05	2.43	129.95	7.22
			100.00	4.30	140.00	12.90
			110.00	8.29		
			113.95	10.76		
$R{=}C_2H_5$	80.00	0.51	50.00	0.07	80.00	0.53
	90.00	1.27	60.00	0.23	89.95	1.09
	100.05	2.59	70.00	0.43	100.05	1.83
			80.00	0.95	110.00	2.66
			89.80	1.96	119.95	3.86
			100.00	3.56	129.95	6.38
			110.05	6.49	140.10	10.69
$R{=}n\text{-}C_3H_7$	94.90	0.70	50.00	0.09	80.00	0.56
			60.00	0.22	89.90	1.04
			70.00	0.42	100.00	1.79
			80.00	0.86	110.00	2.75
			90.10	1.43	120.00	3.84
			100.00	2.45		
			110.00	4.18		
$R{=}n\text{-}C_4H_9$	94.90	0.56	—	—	89.95	0.14
					100.00	0.38
					109.95	0.86
					120.00	1.63
$R{=}n\text{-}C_5H_{11}$	94.90	0.17	—	—	89.90	0.23
					100.00	0.50
					109.90	0.89
					120.00	1.67
$R{=}n\text{-}C_6H_{13}$	—	—	—	—	110.05	0.30
					120.00	0.73

$R.CH_2.CH_2.CONH_2$ $R.CH{=}CH.CONH_2$

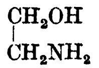
			Cis		Trans	
Melting point						
$R{=}CH_3$	116°0		115°8		157°2	
$R{=}C_2H_5$	105°2		68°1		152°0	
$R{=}n\text{-}C_3H_7$	101°0		68°6		124°8	
$R{=}n\text{-}C_4H_9$	96°6		74°0		125°1	
$R{=}n\text{-}C_5H_{11}$	106°6		74°6		135°1	
$R{=}n\text{-}C_6H_{13}$	99°7		74°5		131°7	
$R{=}n\text{-}C_7H_{15}$	99°2		76°2		123°5	
$R{=}n\text{-}C_8H_{17}$	99°0		77°2		115°5	
Density	t°	d	t°	d	t°	d
$R{=}CH_3$	120	0.8850	120	0.9461	—	—
	130	0.8767	130	0.9370	—	—
$R{=}C_2H_5$	110	0.8735	90	0.9303	—	—
	130	0.8576	110	0.9144	—	—
$R{=}n\text{-}C_3H_7$	110	0.8606	90	0.9099	130	0.8831
	130	0.8456	110	0.8947	140	0.8748
$R{=}n\text{-}C_4H_9$	110	0.8521	90	0.8945	130	0.8683
	130	0.8365	110	0.8795	140	0.8606
$R{=}n\text{-}C_5H_{11}$	110	0.8450	90	0.8836		
	130	0.8304	110	0.8688	140	0.8508
$R{=}n\text{-}C_6H_{13}$	110	0.8394	90	0.8749		
	130	0.8254	110	0.8604	140	0.8424
$R{=}n\text{-}C_7H_{15}$	110	0.8359	90	0.8683	130	0.8436
	130	0.8329	110	0.8542	140	0.8361
$R{=}n\text{-}C_8H_{17}$	110	0.8223	90	0.8627	130	0.8382
	130	0.8190	110	0.8493	140	0.8309

AMINO-ACIDS and DERIVATIVES

d-l-ALANINE: $CH_3—CH(NH_2)—CO_2H$; *d-l*-LEUCINE: $(CH_3)_2\ CH—CH_2—CH(NH_2)—CO_2H$; *d*-ARGININE: $NH_2—C(NH)—NH—(CH_2)_3—CHNH_2—CO_2H$; *l*-TYROSINE: $C_6H_4(OH)CH_2—CH(NH_2)CO_2H$: *Specific heat* and *heat of combustion:* HUFFMAN, FOX and ELLIS (1936–37); CREATINE HYDRATE: $NH{=}C(NH_2)—N(CH_3)CH_2—CO_2H.H_2O$; *d-l*-CITRULLINE: $H_2N—CO—NH—(CH_2)_3—CH(NH_2)—CO_2H$; *d-l*-ORNITHINE: $CH_2NH_2—CH_2—CH_2—CHNH_2—CO_2H$; *l*-PROLINE: $C_4H_8N.CO_2H$: *Specific heat:* HUFFMAN and FOX (1940); *d-l*-ALANYLGLYCINE: $CH_3—CH(NH_2)—CO—NH—CH_2—CO_2H$; HIPPURIC ACID: $CO_2H—CH_2—NH—COC_6H_5$; GLYCYLGLYCINE: $H_2N—CH_2—CO—NH—CH_2—CO_2H$; *d-l*-LEUCYLGLYCINE: $(CH_3)_2CH—CH_2—CH(NH_2)—CO—NH—CH_2—CO_2H$; HIPPURYLGLYCINE: $C_6H_5—CO—NH—CH_2—CO—NH—CH_2—CO_2H$: *Specific heat:* HUFFMAN (1941); GUANIDINE CARBONATE: $(NH{=}C(NH_2)_2)_2H_2CO_3$: *Specific heat:* HUFFMAN, ELLIS and BORSOOK (1940).

C. MISCELLANEOUS DERIVATIVES

MONOETHANOLAMINE


$$\begin{array}{l} CH_2OH \\ | \\ CH_2NH_2 \end{array}$$

Constants: Reitmeier, Sivertz and Tartar (1940)

Boiling point: 170°8 Lecat
171°1

Melting point: 10°5

Density				*Surface tension*			
t°	d	t°	d	t°	γ	t°	γ
25	1.01170	60	0.98366	25	48.30	60	44.41
30	1.00773	70	0.97551	30	47.79	70	43.29
40	0.99983	80	0.96749	40	46.59	80	42.18
50	0.99182			50	45.59		

Refractive index: $n_D^{20^\circ}$ 1.4539

CYANIC ACID $N{\equiv}C.OH$

Constants

Saturated vapour pressure: Linhard (1938)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
−76.27	1.28	−59.86	5.88	−39.34	27.71	−23.97	74.72
−74.97	1.39	−57.92	6.72	−38.52	29.38	−21.14	88.30
−73.80	1.57	−54.13	8.80	−35.93	35.11	−21.12	88.46
−72.12	1.95	−52.56	10.55	−34.76	38.10	−17.99	105.86
−70.25	2.25	−50.22	12.71	−32.19	44.97	−14.97	125.19
−68.21	2.79	−48.47	14.47	−30.09	51.33	−11.63	150.06
−66.77	3.20	−45.43	18.02	−29.74	52.63	− 8.63	175.68
−64.36	3.97	−43.46	20.75	−26.80	62.91	− 5.94	201.98
−62.22	4.78	−40.60	25.50				

ETHYL CARBAMATE or URETHAN $NH_2.CO_2C_2H_5$

Constants

Saturated vapour pressure: Stuckgold (1917)

t°	p mm	t°	p mm	t°	p mm
103.0	54.0	163.0	429.2	172.7	616.2
120.7	108.0	168.9	526.0	175.0	645.0
130.1	146.5	171.1	574.1	176.8	696.7
141.7	214.3				

Boiling point: 185°25 Lecat

Melting point: 48°19 Chadwell and Asnes (1930)

Density and Viscosity

t°	d	$\eta \cdot 10^5$		t°	d	
60	1.0482	2357	Stuckgold	48.2	1.0599	Turner and Pollard (1914)
70	1.0381	1805	„ (1917)			
80	1.0280	1456	„			

*o-m-,p-*AMINOBENZOIC ACIDS: *o-m-*,p,-$NH_2.C_6H_4.CO_2H$, and HYDROXYACETANILIDE: $C_6H_5NH.CO.CH_2OH$: *Heat of melting, specific heat:* Andrews, Lynn and Johnston (1926).

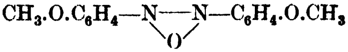
AROMATIC AMIDES. The *density* and the *surface tension* of the following amides were studied by Turner and Merry (1910), but there are no comparison data.

BENZAMIDE (M.P.: 127°2 Skau, (1935)	$C_6H_5.CONH_2$
PHENYLACETAMIDE	$CH_2(C_6H_5).CONH_2$
SALICYLAMIDE	$C_6H_4(OH).CONH_2$
FORMANILIDE	$C_6H_5NH.COH$
METHYLACETANILIDE	$C_6H_5N(CH_3).CO.CH_3$
ETHYLACETANILIDE	$C_6H_5N(C_2H_5).CO.CH_3$
N-PHENYLURETHAN (ETHYL CARBANILATE)	$C_6H_5NH.CO_2C_2H_5$

ACETANILIDE: $C_6H_5NH.CO.CH_3$: *Melting point, density* and *surface tension:* Grinakowsky (1913) and Turner and Merry (1910). Criteria for the impurities: *melting point*: Schwab and Wichers (1944).

ANTIPYRINE or PHENAZONE: $C_{11}H_{12}N_2O$: *melting point, density* and *surface tension:* Grinakowski (1913).

p-AZOXYANISOLE



$CH_3.O.C_6H_4{-}\underset{\diagdown O \diagup}{N{-}N}{-}C_6H_4.O.CH_3$

Melting point

117°8	**Robberecht** (1938)	118°5	**Prins** (1909)
118°3	**Hulett** (1899)	118°5	**Svedberg** (1914)

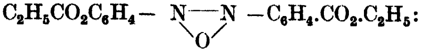
Transition point in the liquid phase (clearing point)

135°5	**Prins** (1909)	135°9	**Robberecht** (1938)
135°6	**Svedberg** (1914)	136°	**Pick** (1911)
135°9	**Hulett** (1899)		

Melting curve

Fusion		*Transition*		
t°	p kg/cm²	t°	p kg/cm²	
117.8	1	135.9	1	**Robberecht** (1938)
118.8	25	136.8	19	,,
120	60	137.6	35	,,
120.8	85	138.7	58	,,
128.2	310	140.8	107	,,
134.8–134.9	500	142.3	130	,,
148.4	600	145.4	200	,,

ETHYL *p*-AZOXYBENZOATE:



$C_2H_5CO_2C_6H_4{-}\underset{\diagdown O \diagup}{N{-}N}{-}C_6H_4.CO_2.C_2H_5$:

Melting point and *specific heat:* **Spaght, Thomas** and **Parks** (1932).

D. AROMATIC NITRO DERIVATIVES

NITROBENZENE $C_6H_5NO_2$

Nitrobenzene is purified by distillation followed by fractional crystallization. The critical temperature of solution in n-C_6H_{14} is a very sensitive criterion of purity.

Constants: B.E. (1935). **Polyphasic equilibria**

Saturated vapour pressure

t°	p mm		t°	p mm	
25	0.340	Brückner (1931)	69.2	4	Kahlbaum (1898)
30	0.425	„	72.9	5	„
35	0.523	„	76.1	6	„
50	0.951	„	79.1	7	„
51.2	1.00	„	81.5	8	„
53.1	1	Kahlbaum (1898)	83.5	9	„
59.8	2	„	85.4	10	„
64.9	3	„	120.2	50	„

Boiling point

210°75	$\frac{dt}{dp}$ *(10 mm):* 0°48	Lecat
210°8		Perkin (1896)
210°85	„ 0°48	B.E. (1935)

Melting point

5°66	Turner and Pollard (1914)	5°70	B.E. (1935) and Deffet (1935)
5°668	Roberts and Bury (1923)	5°72	Sugden (1933)
5°67	Murakami (1932)	5°76	Cohen and Boekhorst (1934)
5°67	Swarts (1914)	5°77	Massy, Warren and Wolfenden (1932)
5°689	Sidgwick and Ewbank (1924)		
5°7	Udovenko and Ayrapetova (1947)	5°82	Meyer (1910)
5°70	Simpson and Jones (1919)		

Melting curve

t°	p kg/cm²	t°	p kg/cm²	
5.70	1	20.00	650	Deffet (1935)
10.05	198	25.00	875	„
15.00	423	27.50	988	„

Critical solution point in n-hexane: 21°0

Constants of state

Density (Liquid state)

t°	d		t°	d	
0	1.22305	B.E. (1935)	20	1.2032	Perkin (1896)
15	1.20834	„	25	1.1985	„
30	1.19341	„	30	1.1936	„
4	1.2193	Perkin (1896)	35	1.1894	„
5	1.2181	„	40	1.1837	„
10	1.2131	„	45	1.1786	„
15	1.20826	„	50	1.1740	„
0	1.22290	Timmermans (1910)	25	1.1982	Sugden (1933)
18	1.20538	Dawson (1910)	25	1.1983	Gibson and Loeffler (1939)
20	1.2032	Brückner (1931)			
20	1.20323	Tyrer (1914)	25	1.1983	Coates and Coates (1944)
20	1.2033	Brand and Kranz (1927)	25	1.19849	Martin and George (1933)
20	1.20340	Biron and Morgoulewa (1914)	25	1.19861	Le Fevre and Le Fevre (1936)
20	1.2034	Herzen (1902)			

t°	d	t°	d	t°	d	t°	d	
1.36	1.22175	5.45	1.21769	8.93	1.21427	13.44	1.20978	Cohen and Boekhorst
2.35	1.22076	5.96	1.21721	9.43	1.21375	14.44	1.20879	„ (1934)
2.95	1.22017	6.43	1.21672	9.93	1.21327	15.45	1.20781	„
3.54	1.21959	6.94	1.21623	10.43	1.21278	16.35	1.20690	„
3.94	1.21919	7.44	1.21571	10.92	1.21228	16.45	1.20681	„
4.44	1.21869	7.94	1.21522	11.43	1.21178	17.45	1.20582	„
4.75	1.21840	8.44	1.21472	12.44	1.21079	19.96	1.20336	„
4.95	1.21819							„

Viscosity

t°	$\eta \cdot 10^5$	
15	2165	B.E. (1935)
30	1634	„

Surface tension

t°	γ	
15	43.95	B.E. (1935)
20	43.35	„
30	42.17	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.54683	1.54785	—	1.55483	1.56947	1.57325	1.58566	B.E. (1935)
$\frac{dn}{dt}$	0.00046	46	—	46	47	48	49	„
20	—	1.5455	1.5524	—	—	1.5713	—	Cotton and Mouton (1910)
20	—	—	1.55230	—	—	—	—	Dummer (1919)
20	—	1.54582	—	—	—	—	—	Brand and kranz (1927)
25	—	—	1.55006	—	—	—	—	Harris (1925)
25	—	1.54348	—	—	—	—	—	Martin and George (1933)

Dielectric constant

t°	ε		t°	ε	
10	37.85	Ball (1930)	54	29.99	Ball (1930)
12.8	37.30	„	60	29.08	„
18	36.23	„	80	26.28	„
25	34.89	„	25	34.890	Le Fevre and Le Fevre (1936)
30	33.97	„			
32.9	33.48	„	20	35.965	Mouradoff (unp.)
40	32.26	„			

Magnetic rotatory power

t°	(μ)	
15	1.6566	Perkin (1896)
19	1.6515	„
56	1.6149	„

Heat constants

Heat of melting	22.50 cal 15°/g	Meyer (1910)

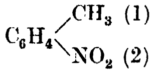
DINITROBENZENES: $C_6H_4(NO_2)_2$:

Ortho: Melting point: Johnston and Jones (1928).

Ortho, meta and *para: Melting point, specific heat* and *heat of melting:* Andrews, Lynn and Johnston (1926).

Meta: Melting point: Reissert (1890); Desvergnes (1925) and Skau (1930–1935); *Melting point* and *heat of combustion:* Garner and Abernetty (1921); Badoche (1939); Robertson (1902) and Rinkenbach (1930).

o-NITROTOLUENE



$C_6H_4\langle{}^{CH_3\ (1)}_{NO_2\ (2)}$

Constants

Saturated vapour pressure: Kahlbaum (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
81.8	5	100.2	13	108.4	19	114.8	25
85.2	6	101.7	14	109.6	20	115.7	26
90.6	8	103.2	15	110.7	21	117.5	28
92.9	9	104.6	16	111.8	22	118.4	29
94.8	10	105.8	17	112.8	23	119.2	30
96.8	11	107.2	18	113.8	24	120.0	31
98.6	12						

Boiling point

221°7	De Beule (1933)	221°75	Lecat (passim)

Melting point

β −3°17	(*stable* form)	De Beule (1933) and Deffet (1935)
α −9°27	(*unstable* form)	„

Melting curve: Deffet (1935)

Stable form β				*Unstable form α*			
t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²
−3.17	1	+10.00	640	−9.27	1	+5.00	716
−0.4	136	15.50	912	−5.0	198	10.00	978
				−0.1	452		

Critical solution point in isopentane: 8°65 Hennaut-Roland (1933)

Density

t°	d		t°	d	
0	1.18229	Hennaut-Roland (1933)	0	1.1820	Bingham and Geddes (1934)
15	1.16781	„	10	1.1723	„
30	1.15321	„	20	1.1626	„
20	1.1629	Brühl (1895)	30	1.1531	„
20.4	1.1625	„	40	1.1435	„
			60	1.1236	„
			80	1.1041	„
			100	1.0842	„

Viscosity

t°	$\eta \cdot 10^4$		t°	$\eta \cdot 10^4$	
15	262.2	Hennaut-Roland (1933)	30	194	Bingham and Geddes
30	191.1	,,	40	163	,, (1934)
0	383	Bingham and Geddes	60	121	,,
10	296	,, (1934)	80	94	,,
20	237	,,	100	76	,,

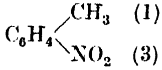
Surface tension

t°	γ		t°	γ	
15	42.29	Hennaut-Roland (1933)	19.5	41.76	Sugden and Wilkins (1925)
20	41.67	,,			
30	40.50	,,			

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.	
15	1.54144	1.54231	1.54884	1.56220	1.56570	1.57732	Hennaut-Roland (1933)
$\frac{dn}{dt}$	0.00046	46	47	48	49	50	,,

m-NITROTOLUENE



$C_6H_4\left\langle\begin{array}{l}CH_3 \ (1)\\ NO_2 \ (3)\end{array}\right.$

Constants: Hennaut-Roland (1933)

Boiling point		*Melting point*	
232°6	De Beule (1933)	16°05	Deffet (1935)
		16°1	Scheuer (1910)
		16°10	De Beule (1933)

Melting curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²
16.05	1	25.00	372	35.00	781
20.00	164	30.00	578	40.00	982

Critical solution point in isopentane: 7°05

Density

t°	d
15	1.16176
20	1.15712
30	1.14766

Viscosity

t°	$\eta \cdot 10^5$
15	2563
30	1777

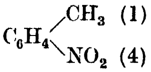
Surface tension

t°	γ
15	41.73
30	39.91

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.54144	1.54229	1.54918	1.56296	1.56673	1.57856
$\frac{dn}{dt}$	0.00045	44	46	46	49	49

p-NITROTOLUENE


$C_6H_4\begin{cases}CH_3 & (1)\\ NO_2 & (4)\end{cases}$

Constants: B.E. (1937)

Saturated vapour pressure: Kahlbaum (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
92.3	5	107.5	11	112.4	14	116.6	17
95.7	6	109.3	12	113.9	15	117.8	18
101.2	8	110.9	13	115.3	16	119.1	19
105.6	10						

Boiling point

238°34	Berliner and May (1926)
238°4	De Beule (1933)
238°5	$\frac{dt}{dp}$ *(10 mm):* 0°54 B.E. (1937)
238°9	Lecat
238°9	Neubeck (1887)

Melting point

51°6	Berliner and May (1926)
51°6	De Beule (1933)
51°65	B.E. (1937) and Deffet (1935)
52°06	Desvergnes (1925)
52°1	Garner and Abernetty (1921)

Melting curve: Deffet (1935)

t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²
51.65	1	65.00	483	74.95	857
55.00	112	70.00	671	77.95	972
60.00	297				

Density

t°	d	t°	d	
55	1.12259	70	1.10857	B.E. (1937)
60	1.11788	75	1.10392	
65	1.11324			

Viscosity

t°	$\eta \cdot 10^5$	
60	1204	
75	980	

Surface tension

t°	γ	
60	36.83	
70	35.64	

Refractive index

t°	He r.	Hα	D	He y.	He g.
15	1.53019	1.53123	1.53818	1.53844	1.55347
$\frac{dn}{dt}$	0.00044	44	—	44	45

2,4,6-TRINITROTOLUENE $C_6H_2(CH_3)(NO_2)_3$ (2,4,6)

Melting point: 80° 1

Velocity of crystallization: Campbell and Pritchard (1947)

t°	mm/min.	t°	mm/min.	
30.0	171	60.0	94	
40.0	158	70.0	35	
50.0	126			

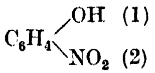
PICRATES of PRIMARY, SECONDARY and TERTIARY AMINES and of QUATERNARY AMMONIUM BASES: $C_6H_2.(NO_2)_3.ONH_3R$ (R = alkyl), $ONH_2(R)_2$, $ONH(R)_3$, $ON(R)_4$: *Melting point, viscosity* and *conductivity:* Walden, Ulich and Birr (1928).

p-NITROSOMETHYLANILINE (Phenylmethylnitrosamine) $C_6H_5N(NO)CH_3$: *Density* and *refractive index:* Cowley and Partington (1933) and *density* and *surface tension:* Turner and Merry (1910).

α-NITRONAPHTHALENE: $C_{10}H_7NO_2$-α: *Melting point:* Patterson (1908); Cumming and Steel (1923); *Melting point* and *Heat of Combustion:* Rinkenbach (1930) and Badoche (1937).

1,5 and 1,8-DINITRONAPHTHALENE: $C_{10}H_6(NO_2)_2$ and 1,3,8 and 1,4,5-TRINITRONAPHTHALENE: $C_{10}H_5(NO_2)_3$: *Melting point* and *heat of combustion:* Rinkenbach (1930) and Badoche (1937).

o-NITROPHENOL



$C_6H_4\begin{matrix}\diagup OH\ (1)\\ \diagdown NO_2\ (2)\end{matrix}$

Constants

Boiling point

217°2	LECAT

Melting point

44°9	SIDGWICK, SPURREEL and DAVIES (1915)
44°95	HULETT (1899)
45°	EFREMOW (1919)
45°1	GARNER and ABERNETTY (1921)

Melting curve: HULETT (1899)

t°	p atm/cm^2	t°	p atm/cm^2	t°	p atm/cm^2
44.95	1	47.85	125	50.90	250
45.40	25	48.40	150	51.60	275
46.10	50	48.95	175	52.00	300
46.80	75	49.60	200		
47.25	100	50.25	225		

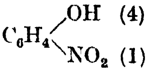
Density

t°	d		t°	d	
30	1.3045	BRAMLEY (1916)	60	1.2712	BRAMLEY (1916)
40	1.2942	„	80	1.2482	„

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
30	3650	BRAMLEY (1916)	60.1	1825	BRAMLEY (1916)
40	2755	„	80	1348	„

p-NITROPHENOL


$C_6H_4<^{OH\ (4)}_{NO_2\ (1)}$

Constants

Saturated vapour pressure: Campbell and Campbell (1941)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
120	0.60	150.5	3.17	162	5.63	177	12.62
130	0.93	153	3.47	165	6.92	182	15.2
142	1.91	156	3.81	168	7.59	184	17.4
146	2.24	157	4.27	169	8.71	186	18.7
149	2.82						

Melting point

113°8	Kendall (1914–16)	114°	Swarts (1914)
113°8	Sidgwick, Spurrell and Davies (1915)	114°	Schiff (1884)
114°	Bellucci and Grassi (1913)	114°1	Efremow (1919)

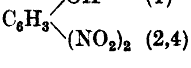
Density: 117°3 1.282 Campbell and Campbell (1941)

Viscosity: $\eta \cdot 10^5$ 121° 2560 ,,

Surface tension γ*:* 121° 46.3 ,,

Heat of melting	41.7 cal 15°/g	Campbell and Campbell (1941)

2,4-DINITROPHENOL


$C_6H_3<^{OH\ (1)}_{(NO_2)_2\ (2,4)}$

Constants

Melting point

112°8	Grinakowski (1913)	113°	Holleman and Wilhelmy (1902)
112°8	Bogojawlensky (1902)	114°	Kendall (1914)
112°9	Sidgwick and Aldous (1921)		

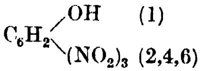
Velocity of crystallization

t°	mm/min.		t°	mm/min.	
40	88.3	Bogojawlensky (1898)	80	30.3	Bogojawlensky (1898)
50	83.2	„	90	16.2	„
60	76.8	„	100	6.35	„
70	55.7	„			

Density

t°	d		t°	d	
72.5	1.4829	Grinakowski (1913)	111.0	1.4386	Grinakowski (1913)
84.0	1.4664	„	121.0	1.4281	„
101.0	1.4484	„	132.5	1.4157	„

PICRIC ACID or 2,4,6-TRINITROPHENOL



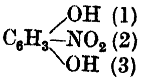
$C_6H_2\left\langle\begin{matrix}OH & (1)\\ (NO_2)_3 & (2,4,6)\end{matrix}\right.$

Melting point: 122° Bogojawlensky (1898)

Velocity of crystallization

t°	mm/min.		t°	mm/min.	
80	858	Bogojawlensky (1898)	95	783	Bogojawlensky (1898)
85	858	„	100	681	„
90	811	„	110	343	„

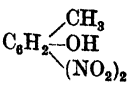
2-NITRORESORCINOL



$C_6H_3\left\langle\begin{matrix}OH\ (1)\\ NO_2\ (2)\\ OH\ (3)\end{matrix}\right.$

Melting point, density and *viscosity:* Friend and Hargreaves (1946).

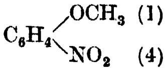
DINITRO-*o*-CRESOLS



$C_6H_2\left\langle\begin{matrix}CH_3\\ OH\\ (NO_2)_2\end{matrix}\right.$

Saturated vapour pressure: Balson (1947)

p-NITROANISOLE



$C_6H_4\left<\begin{array}{ll}OCH_3 & (1)\\ NO_2 & (4)\end{array}\right.$

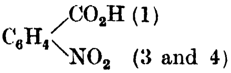
Constants: Puschin and Grebenschtschikow (1912)

Melting point: 52°5

Melting curve

t°	p kg/cm²	t°	p kg/cm²	t°	p kg/cm²
52.5	1	76.1	1050	90.1	1750
65.0	550	80.3	1250	96.2	2050
69.4	750	86.2	1550	100.0	2250

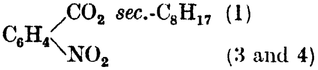
m and *p*-NITROBENZOIC ACIDS:



$C_6H_4\left<\begin{array}{ll}CO_2H & (1)\\ NO_2 & (3\ \text{and}\ 4)\end{array}\right.$

Melting point: Bakunin and Angrisani (1915) and *melting point, specific heat* and *heat of fusion:* Andrews, Lynn and Johnston (1926).

*sec.*OCTYL *m* and *p*-NITROBENZOATES *d* and *l:*

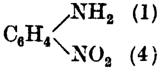


$C_6H_4\left<\begin{array}{ll}CO_2\ sec.\text{-}C_8H_{17} & (1)\\ NO_2 & (3\ \text{and}\ 4)\end{array}\right.$

Density and *rotatory power:* Rule and Numbers (1926)

METHYL *l*-α-*o*-NITROBENZOYLOXYPROPIONATE: $C_6H_4(NO_2)CO.O.CH_2.CH_2.CO_2CH_3$: *Density* and *rotatory power:* Patterson and Lawson (1929).

p-NITROANILINE



$C_6H_4\left<\begin{array}{ll}NH_2 & (1)\\ NO_2 & (4)\end{array}\right.$

Constants

Melting point

147°	Gross and Saylor (1931)	147°5	Collett and Johnston (1926)
147°0	Efremow (1927)	147°5	Swarts (1914)
147°5	Andrews, Lynn and Johnston (1926)	148°3	Holleman, Hartogs and Van der Linden (1911)
147°5	Johnston and Jones (1928)		

Specific heat	147°5 L. 0.479 cal 15°/g	Andrews, Lynn and Johnston (1926)
	147°5 C. 0.447 „	„
	25° C. 0.293 „	„
Heat of fusion	36.50 „	„

12. MIXED HALOGENATED NITROGEN DERIVATIVES

CYANOGEN CHLORIDE CNCl

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−6	342.1	1.85	483.6	9.10	658.3	DOUGLAS and WINKLER
−5.6	348.3	3.40	515.4	10.60	697.3	„ (1947)
−4.8	359.1	5.00	558.0	12.80	754.8	„
−2.8	396.3	6.20	581.2	13.00	763.0	„
0.00	446.5	7.40	616.5	17.82	916.5	„
−12	233					
−10	265	− 2	408	8	621	KLEMENC and WAGNER
− 8	302	0	445	10	674	„ (1938)
− 6	341	2	484	12	730	„
− 4	373	4	527	14	790	„
		6	573			„

Boiling point

13°0	KLEMENC and WAGNER (1938)

Freezing point

−6°5	KLEMENC and WAGNER (1938)
−6°90	DOUGLAS and WINKLER (1947)

Triple point: — 6°3/337 mm KLEMENC and WAGNER (1938)

CYANOGEN IODIDE CNI

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
25.0	1.2	51.45	7.1	70.69	23.6	JOST and STONE (1933)
46.15	4.7	55.42	8.9	73.34	28.7	„
49.88	5.9	66.44	18.3	81.42	43.4	„
				100.93	121.7	„
79.3	41.4	119.6	314.0	139.8	755.0	KETELAAR and KRUYER
89.2	77.7	122.0	343.1	142.1	838	„ (1943)
100.6	117.5	123.2	360.3	146.0	976	„
105.0	153.0	124.8	400.9	148.0	1040	„
108.8	186.2	128.2	466.9	149.6	1085	„
113.1	238.5	133.9	605.6	151.6	1153	„

Triple point: 146°/993 mm KETELAAR and KRUYER (1943)

Heat of sublimation	93.58 cal 15°/g	KETELAAR and KRUYER (1943)
Heat of vaporization	62.52 ,,	,,
Heat of melting	31.06 ,,	,,

α-CHLORO-NITRILES

Constants: VANDEWYER (1935)

	Density		*Refractive index*				
	15°	30°	t°	Hα	D	Hβ	Hγ
$CH_2Cl—CN$	1.20269	1.18322	15	1.42326	1.42562	1.43140	1.43575
			30	1.41685	1.41905	1.42459	1.42913
$CH_3—CHCl—CN$	1.07398	1.05581	15	1.41166	1.41386	1.41918	1.42346
			30	1.40518	1.40734	1.41260	1.41700
$C_2H_5—CHCl—CN$	1.03901	1.02245	15	1.42124	1.42348	1.42887	1.43336
			30	1.41513	1.41725	1.42263	1.42703
$C_3H_7—CHCl—CN$	1.00777	0.99241	15	1.42649	1.42864	1.43412	1.43863
			30	1.42042	1.42261	1.42805	1.43248
$C_4H_9—CHCl—CN$	0.98801	0.97381	15	1.43217	1.43439	1.43996	1.44440
			30	1.42620	1.42841	1.43387	1.43824
$C_5H_{11}—CHCl—CN$	0.97138	0.95765	15	1.43591	1.43819	1.44384	1.44843
			30	1.43016	1.43240	1.43787	1.44230
$C_6H_{13}—CHCl—CN$	0.95889	0.94559	15	1.43900	1.44136	1.44693	1.45154
			30	1.43359	1.43583	1.44145	1.44594
$C_7H_{15}—CHCl—CN$	0.94868	0.93602	15	1.44179	1.44412	1.44975	1.45434
			30	1.43663	1.43878	1.44445	1.44882
$C_8H_{17}—CHCl—CN$	0.94068	0.92834	15	1.44444	1.44673	1.45234	1.45691
			30	1.43924	1.44146	1.44704	1.45136
$C_9H_{19}—CHCl—CN$	0.93345	0.92151	15	1.44635	1.44866	1.45445	1.45901
			30	1.44133	1.44354	1.44917	1.45369

γ-CHLOROBUTYRO-, β-CHLORO *iso*-BUTYRO-, γ-CHLOROCROTO- and β-CHLORO-α-METHYLACRYLONITRILES: $CH_2Cl—CH_2—CH_2—CN$, $CH_2Cl—CH(CH_3)—CN$, $CH_2Cl—CH{=}CH—CN$, $CHCl{=}C(CH_3)—CN$: *Boiling point, density* and *refractive index:* BERTHET (1941).

α-ETHYL-β-CHLOROBUTYRONITRILE: $CH_3—CHCl—CH(C_2H_5)—CN$: *Boiling point, density* and *refractive index:* BRUYLANTS and ERNOULD (1932).

α-BROMOCROTONITRILES: $CH_3—CH{=}CBr—CN$: *Boiling* and *melting points, density* and *refractive index:* LECLERQ and BRUYLANTS (1949)

BROMOBENZYLCYANIDE: $C_6H_4Br—CH_2—CN$: *Saturated vapour pressure*: Balson (1947)

α-BROMOCROTONAMIDES: $CH_3—CH{=}CBr—CONH_2$: *Melting point:* Leclerq and Bruylants (1949)

CHLOROPICRIN: $C\,Cl_3NO_2$: *Saturated vapour pressure:* Oyaiza (1927) and Blaszkowska-Zakrzewska (1928). Their values do not agree.

d-GLUTAMIC ACID HYDROCHLORIDE: $CO_2H.CH_2.CH_2.CH.(NH_2).CO_2H.HCl$ and ORNITHINE DIHYDROCHLORIDE: $NH_2CH_2.(CH_2)_2.CH(NH_2).CO_2H.2HCl$: *Specific heat:* Huffman, Ellis and Borsook (1940)

METHYLAMMONIUM CHLORIDE $CH_3\,NH_3\,Cl$

Constants: Aston and Ziemer (1946) (M.W. 67.523)

Specific heat:

t°	c_p	t°	c_p	t°	c_p
γ Form					
L. −249.78	0.03230	−161.75	0.21261	−70.74	0.27836
−238.41	0.06521	−149.20	0.22428	−60.46	0.28393
−227.89	0.09724	−135.00	0.23629	−50.70	0.29029
−210.07	0.1397	−126.72	0.24264	−37.27	0.29615
−201.45	0.15750	−111.37	0.25311	−30.91	0.3000
−187.23	0.18167	−102.77	0.26031	−20.37	0.3048
−180.93	0.19067	− 90.56	0.26736	−13.32	0.3080
−170.95	0.20349	− 77.03	0.27527	− 1.09	0.3344
β Form					
L. −260.06	0.00372	−190.80	0.16104	−119.32	0.24082
−249.18	0.02275	−178.42	0.18083	−110.20	0.24806
−241.88	0.04138	−172.08	0.18956	−103.50	0.25333
−228.91	0.07698	−161.42	0.20172	−89.75	0.26326
−218.94	0.1022	−148.67	0.21433	−76.67	0.27191
−210.96	0.1210	−138.10	0.22472	−65.94	0.27976
−203.16	0.1371	−131.66	0.23118	−59.83	0.28484
α Form					
L. −45.96	0.3033	−7.39	0.3089	12.80	0.3162
−40.11	0.3021	−7.19	0.3091	13.16	0.3166
−33.61	0.3028	−0.93	0.3120	16.63	0.3191
−27.09	0.3040	+5.70	0.3143	18.94	0.3199
−20.10	0.3051	5.89	0.3154	20.55	0.3203
−14.10	0.3070	6.13	0.3154	24.81	0.3254

Heats of transition

Lower: −52°76 6.297 cal 15°/g
Higher: − 8°66 9.976 cal 15°/g

TETRAMETHYLAMMONIUM IODIDE $(CH_3)_4 NI$

Specific heat: Coulter, Pitzer and Latimer (1940) (M.W. 201.03)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −259.06	0.008526	−182.34	0.08974	−106.21	0.1323	−28.41	0.1700
−249.33	0.02555	−173.90	0.09501	− 87.82	0.1413	−19.79	0.1711
−238.99	0.04222	−165.50	0.1001	− 77.84	0.1462	−10.98	0.1768
−231.45	0.05278	−156.66	0.1053	− 67.89	0.1507	8.93	0.1865
−218.34	0.06521	−147.33	0.1106	− 58.63	0.1547	16.83	0.1880
−209.30	0.07272	−140.62	0.1146	− 48.88	0.1592	24.37	0.1917
−198.06	0.07939	−123.56	0.1229	− 38.63	0.1631		
−190.39	0.08461						

ANILINE HYDROCHLORIDE $C_6H_5 NH_2.HCl$

Constants: Leopold (1910)

Saturated vapour pressure

t°	p mm	t°	p mm
S. + G. 113	3	S. + L. + G. 198	162
137	9	199.2	222
156	23	L. + G. 202	248
180	73	205	273
197.5	158	207	297

FLUOROANILINES $C_6H_4FNH_2$

Constants: Swarts (1913–19–23–31)

Ortho	*Meta*	*Para*
Boiling point —	186°4 Swarts (1913) 186°3 „ (1919)	187°4 Swarts (1913–19)
Melting point —	—	0°82 Swarts (1919)
Density 10° 1.1437 Schiemann (1931)	15°8 1.16015 Swarts (1913–23) 15°8 1.16004 Swarts (1919)	16°9 1.1613 Swarts (1913) 25°2 1.15236 Swarts (1919–23)

(continued)

Ortho			*Meta*			*Para*		
Viscosity								
t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
20.27	2565	Swarts (1931)	25	2475	Swarts (1931)	20	3025	Swarts (1931)
30.05	2090	,,	30	2200	,,	30	2370	,,
40	1700	,,	40	1750	,,	40.05	1925	,,
50	1405	,,	50	1480	,,	50.03	1580	,,
60	1198	,,	60	1250	,,	60	1340	,,
Refractive index								
	18°		15°8		25°2	18°5		20°
Hα	1.54118		1.5414		1.53000	1.53975		1.53618
D	1.54672		1.54737		—	1.54528		1.53945
Hβ	1.56263		1.56157		1.55155	1.56132		1.56078
Hγ	1.57174		1.57710		1.56530	1.57520		1.57344
	Schiemann (1931)		Swarts (1923)			Schiemann (1931)		

2,5-DIFLUOROANILINE $C_6H_3F_2NH_2$

Constants: Swarts (1914–23–31)

Freezing point: 13°45

Density: 18°1 1.2880

Viscosity

t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	
20	2320		50	1325	
30	1875		59.95	1135	
40	1564				

Refractive index

t°	Hα	D	Hβ	Hγ	
18.1	1.5107	1.51454	1.52983	1.54240	

o-CHLOROANILINE $o\text{-}C_6H_4\,Cl\,NH_2$

Constants

Saturated vapour pressure: Kahlbaum (1898)

t°	p mm	t°	p mm	t°	p mm	t°	p mm
104.2	25	109.1	31	114.6	39	118.1	45
105.1	26	109.9	32	115.2	40	118.6	46
105.9	27	110.6	33	115.8	41	119.1	47
106.8	28	111.3	34	116.4	42	119.7	48
107.6	29	112.0	35	117.5	44		
108.4	30	114.0	38				

Boiling point: 207°0 Sidgwick and Rubie (1921)

BROMOANILINES: *o, m* and $p\text{-}C_6H_4\,Br\,NH_2$: *Boiling point* and *refractive index:* Brühl (1895); *Density* and *viscosity*: Bingham and Geddes (1934).

FLUORONITROBENZENES $C_6H_4\,F\,NO_2$

Constants

	Meta	*Para*
Boiling point	200°37 Swarts (1913)	205° Wallach and Heussler (1886) 205° Beekman (1904) 206°7 Swarts (1913)
Freezing point	3°6 Swarts (1913–19) α 4°1 Hasselblatt (1913) β 3°1 „	26°5 Wallach and Heussler (1886) 26°5 Beekman (1904) 27° Swarts (1913–19) 27° Van Hove (1926)
Density	17°2 1.3273 Swarts (1913–23) 19° 1.3254 Schiemann (1931)	20° 1.3300 Schiemann (1931) 84°48 1.2583 Beekmann (1904)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$		t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
25	2180	45	1520	Swarts (1931)	30.1	2245	60.45	1332	Swarts
30.1	1985	55	1305	„	40.05	1840	65	1248	„ (1931)
35	1797	64.8	1148	„	50	1560			„

Refractive index

	17°2	19°	20°	56°1
Hα	1.52171	1.52007	1.52471	1.51004
D	1.52800	1.52622	1.53156	1.5150
Hβ	1.54490	1.54281	1.54876	1.53252
Hγ	1.56072	1.55889	1.56567	1.54880
	Swarts (1923)	Schiemann (1931)	Schiemann (1931)	Swarts (1923)

CHLORONITROBENZENES: $C_6H_4\,Cl\,NO_2$. The data published for *ortho* and *para* chloronitrobenzenes are incompatible. Only *meta* chloronitrobenzene seems to have been thoroughly studied.

m-CHLORONITROBENZENE $m\text{-}C_6H_4\,Cl\,NO_2$

Constants

Melting point

24°0	*metastable* form	Hasselblatt (1913)	44°5	*stable* form	Jagielski (1936)
44°6	*stable* form	„	44°4		Beekman (1904)
44°5		Puschin (1926)	44°4		Bogojalensky and Winogradow (1908)
44°5		Menschutkin (1909)	44°2		Dodd and Hu Pak Mi (1949)

Melting curve

t°	p kg/cm²		t°	p kg/cm²	
51.6	350	Puschin (1926)	83.9	1750	Puschin (1926)
59.1	650	„	90.5	2050	„
68.5	1050	„	96.5	2350	„
73.1	1250	„	98.3	2450	„
79.8	1550	„			

Density

t°	d		t°	d	
80.5	1.3112	Holleman and de Bruyn (1900)	79.4	1.3112	Jagielski (1936)
			92.9	1.2963	„
80.5	1.3112	Beekman (1904)	99.4	1.2898	„
50.4	1.3422	Jagielski (1936)	128.5	1.2582	„
61.6	1.3305	„	135.3	1.2508	„
70.5	1.3208	„	143.6	1.2413	„

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
21.1	3093	66.7	1478	107.3	903	JAGIELSKI (1937)
21.9	3049	74.6	1323	112.9	854	,,
29.5	2752	82.4	1195	122.3	780	,,
35.6	2508	86.7	1135	129.1	732	,,
42.1	2214	93.8	1048	136.5	689	,,
47.4	2004	99.7	991	140.3	668	,,
53.7	1804	100.4	972	145.9	644	,,
59.7	1637					,,

Viscosity from 25° to 60°: see diagram: DODD and HU PAK MI (1949).

m-BROMONITROBENZENE: *m*-$C_6H_4BrNO_2$: *Boiling point:* BEEKMAN (1904) and NARBUTT (1905); *density*: BRÜHL (1897) and BEEKMAN (1904); *refractive index:* BRÜHL (1897) and JÜRGENS (1924); *heat of melting:* BOGOJALENSKY and WINOGRADOW (1908).

	4-CHLORO-1,2-DINITRO-BENZENE $C_6H_3Cl(NO_2)_2$				4-BROMO-1,2-DINITRO-BENZENE $C_6H_3Br(NO_2)_2$			
Constants: MÜLLER (1914)								
Melting point	f. I	50°			*Stable* f.	59°5		
	f. II	43°			*Metast.* f.	34°8		
	f. III	27°						
	f. I	50°09 DESVERGNES (1925)						
Density	t°	d	t°	d	t°	d	t°	d
	30	1.5001	60	1.4699	40	1.8239	70	1.7889
	40	1.4898	70	1.4602	50	1.8132	80	1.7590
	50	1.4799			60	1.8011		
Surface tension	t°	γ	t°	γ	t°	γ	t°	γ
	30	13.786	60	12.301	40	13.276	70	11.969
	40	13.281	70	11.825	50	12.832	80	11.545
	50	12.782			60	12.398		

o and *m*-NITROCHLOROACETOPHENONES: $C_6H_4(NO_2).CO.CH_2Cl$: *Saturated vapour pressure:* BALSON (1947).

13. SULPHUR DERIVATIVES

CARBON DISULPHIDE

Many authors recommend a chemical treatment in order to get rid of traces of sulphur in carbon disulphide; but in our opinion this treatment can be avoided by using a good dephlegmator.

Impurities such as H_2S and S may be detected by the methyleneblue reaction down to a concentration of 5×10^{-6} % (Gillo, 1938). This author corroborates the fact that it is easy to attain the fifth degree of purity (Δ t° = 0°000). The pure samples must be kept in the dark.

Constants: B.E. (1928). — **Polyphasic equilibria**

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−18	51.9	−3	110.7	12	215.4	Stock, Henning and Kuss (1921)
−17	54.8	−2	116.0	13	224.5	„
−16	57.8	−1	121.6	14	234.0	„
−15	60.9	0	127.3	15	243.8	„
−14	64.2	+1	133.3	16	254.0	„
−13	67.6	2	139.5	17	264.3	„
−12	71.2	3	145.9	18	275.0	„
−11	74.9	4	152.6	19	286.1	„
−10	78.8	5	159.5	20	297.5	„
− 9	82.8	6	166.7	21	309.2	„
− 8	87.0	7	174.0	22	321.3	„
− 7	91.4	8	181.8	23	333.8	„
− 6	95.9	9	189.8	24	346.6	„
− 5	100.7	10	198.1			„
− 4	105.6	11	206.6			„
−50	7	−15	61	8	182	Seelig (1920)
−45	10	−10	79	10	198	„
−40	14	− 5	100	12	215	„
−35	19	0	128	14	233	„
−30	26	2	140	16	254	„
−25	35	4	153	18	276	„
−20	46.5	6	167	20	298	„
−78.2	0.68	−21.53	42.69	10.15	199.46	Siemens (1913)
−42.60	11.81	−11.12	74.23	19.66	294.27	„
−31.70	23.64	− 0.01	127.00	46.24	760.0	„
−23.49	39.11	18.37	279.52	60.23	1172.7	Crafts (1913)
− 9.57	81.15	32.35	472.56	74.20	1741.5	„
+ 4.40	155.80	46.26	760			„

Saturated vapour pressure (continued)

t°	p mm	t°	p mm	t°	p mm	
−25.35	34.3	0	127.25			Henning and Stock
− 8.30	85.7	11.54	211.3			,, (1921)
0	127.9	20	298.05	40	617.5	Ramsay and Young
5	160.0	25	361.1	45	729.5	,, (1887)
10	198.45	30	434.5	50	857.1	,,
15	244.15	35	519.65			,,
15.5	247.8	20.5	303.0			Joukovsky (1934)
18.0	274.6	22.8	331.1			,,
19.3	290.1	24.3	350.3			,,
29.942	433.6	51.780	906.1	74.213	1741.0	Zmaczynski (1930)
35.334	525.76	57.334	1074.6	79.912	2026.3	,,
40.780	633.90	62.925	1268.1	85.646	2347.4	,,
46.262	760.00	68.551	1489.2			,,
20	297.4	Sameshima (1935)		0	126.4	Rex (1906)
25	361.1	,,		10	197.6	,,
30	434.6	,,				
0.32	128.5	Roland (1928)		20	298	Faust (1912)
15	243.2	,,		29.2	425.0	Hirshberg (1932)

Boiling point

46°2	Faust (1912)	46°25	Grimm and Patrick (1923)
46°20	Stull (1937)	46°26	Crafts (1913)
46°21	Rodger and Watson (1896)	46°262	Zmaczynski (1930)
46°23	Mathews (1926)	46°28	Ramsay and Young (1887)
46°24	Siemens (1913)	46°29	Sameshima (1925)
46°25	B.E. (1928) and Lecat	46°34	Rosanoff and Easley (1909)
46°25	Tyrer (1914)		
46°25	Gjaldbaek and Hildebrand (1949)		

$\frac{dt}{dp}$ *(10 mm)*: 0°42 B.E. (1928) and Lecat

Freezing point

−111°51 −111°53	STULL (1937) CLUSIUS ans RINGER (1940)	−111°6	TIMMERMANS, VAN DER HORST and KAMERLINGH ONNES (1922)

Constants of state

Density

t°	d		t°	d	
0	1.29270	B.E. (1928)	20	1.2632	MATHEWS (1926)
15	1.27055	„	20	1.2632	LOWRY (1914)
30	1.24817	„	25	1.25585	SAMESHIMA (1925)
0	1.29272	TIMMERMANS (1923)			

$dt = 1.29272 - 148.1\cdot10^{-5}t - 30.6\cdot10^{-8}t^2$ TIMMERMANS (1923) (under 0°)

Specific volume at different temperatures: THORPE and RODGER (1894)

Viscosity

t°	$\eta\cdot10^5$		t°	$\eta\cdot10^5$	
0	436	B.E. (1928)	−13	514	FAUST (1912)
15	380	„	−10	495	„
20	363	„	0	440	„
			15	383	„
			20	367	„
			35	332	„

Surface tension

t°	γ	
15	33.07	HENNAUT-ROLAND and LEK (1931)
20	32.25	„
30	30.79	„

Refractive index

t°	He r.	Hα	D	He y.	He g.	*Hβ	Hγ	
15	1.62115	1.62222	1.63189	1.63220	1.65198	1.65670	1.67912	B.E. (1928)
$\frac{dn}{dt}$	0.00077	77	78	78	80	81	82	,,
20	—	1.61846	—	—	—	1.65267	1.67515	Wüllner (1868) (6°9–23°)
$\frac{dn}{dt}$	—	0.000774	—	—	—	819	—	,,
15	—	—	1.63190	—	—	—	—	Pulfrich (1887)
$\frac{dn}{dt}$	—	—	0.00083	—	—	—	—	,,
3.5	—	—	1.64143	—	—	—	—	Berghöff (1894)
22.7	—	—	1.62522	—	—	—	—	,,
$\frac{dn}{dt}$	—	—	0.00084	—	—	—	—	,,
14.6	—	—	1.63230	—	—	—	—	Ketteler (1888)
20.1	—	—	1.62803	—	—	—	—	,,
23.5	—	—	1.62543	—	—	—	—	,,
$\frac{dn}{dt}$	—	—	0.00077	—	—	—	—	,,

Dielectric constant

t°	ε		t°	ε	
18	2.652	Kyropoulos (1927)	−20	2.6858	Le Fevre (1938)
20	2.647	,,	−10	2.6721	,,
23.5	2.65	Kahlenberg and Anthony (1906)	0	2.6581	,,
			10	2.6438	,,
			20	2.6318	,,
20	2.6331	Piette (1947)	25	2.6246	,,
			30	2.6170	,,
			40	2.6030	,,

Molecular magnetic rotatory power: 20° 9.80 Lowry (1914)

Heat constants

Specific heat: Brown and Manow (1937)

t°	c_p	t°	c_p
C. −258.11	0.0217	L. −103.65	0.2364
−209.69	0.1172	−67.88	0.2365
−169.16	0.1492	−11.50	0.2381
−122.69	0.1742	+24.27	0.2387
(other temperatures, see authors)			

Heat of vaporisation	(B.P.) 83.8 cal 15°/g	Grimm and Patrick (1923)
	(46°29) 84.07 „	Mathews (1926)
Heat of melting	13.802 „	Brown and Manow (1937)

CARBON SESQUISULPHIDE: C_2S_3: *Melting point* and *saturated vapour pressure:* Stock and Praetorius (1912).

METHYL MERCAPTAN CH_3SH

Constants: Russell, Osborne and Yost (1942)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm
−51.280	41.13	−9.474	399.30	5.977	760.64
−23.872	201.46	+ 0.029	599.40		

Boiling point: 5°96

Melting point: −121°0 Timmermans

−123°00

Transition point: −135°56

Specific heat

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C.I −258.19	0.0161	−235.17	0.1019	−184.32	0.2285	L. −117.54	0.4422
−257.34	0.0184	−233.55	0.1113	−179.90	0.2355	−112.66	0.4401
−256.69	0.0204	−232.43	0.1155	−179.04	0.2366	−111.09	0.4391
−255.68	0.02341	−229.55	0.1255	−173.78	0.2441	−106.36	0.4380
−255.18	0.02549	−228.76	0.1283	−168.29	0.2515	− 98.69	0.4359
−253.81	0.02983	−225.08	0.1406	−162.79	0.2592	− 89.05	0.4339
−253.67	0.03068	−224.86	0.1413	−157.46	0.2663	− 78.85	0.4324
−251.99	0.03686	−220.52	0.1546	−155.96	0.2680	− 68.65	0.4314
−251.66	0.03815	−220.12	0.1556	−152.29	0.2734	− 58.53	0.4305
−249.90	0.04507	−216.44	0.1652	−150.87	0.2750	− 48.48	0.4303
−249.22	0.04781	−215.70	0.1671	−147.26	0.2798	− 38.53	0.4310
−247.53	0.05490	−211.30	0.1777	−145.10	0.2829	− 28.68	0.4326
−246.59	0.05885	−210.63	0.1793	−142.35	0.2869	− 18.93	0.4341
−244.99	0.06559	−206.16	0.1893	−140.13	0.2900	− 9.27	0.4366
−243.79	0.07069	−201.01	0.1996	−139.95	0.2904	− 2.10	0.4393
−242.19	0.07731	−195.82	0.2098	C.II −139.94	0.2902		
−240.65	0.08361	−190.58	0.2185	−132.74	0.3091		
−239.30	0.08908	−185.27	0.2272	−126.59	0.3632		
−237.20	0.09750						

Heat of vaporisation	(B.P.) 122.10 cal 15°/g	
Heat of melting	29.348 „	
Heat of transition	1.09 „	

ETHYL MERCAPTAN C_2H_5SH

Constants: Berthoud and Brum (1924)

Critical constants

t° cr.	d cr.
225.5	0.2996

Densities of the liquid and the saturated vapour

t°	L.	V.	t°	L.	V.
0	0.8623	0.0006	154.8	0.6456	0.0402
11.5	0.8500	0.0011	164.5	0.6234	0.0494
32.8	0.8240	0.0025	179.6	0.5913	0.0633
77.6	0.7660	0.0072	190.4	0.5617	0.0801
99.7	0.7342	0.0118	200.5	0.5322	0.0962
118.6	0.7070	0.0185	210.1	0.4986	0.1180
128.0	0.6947	0.0211	216.2	0.4691	0.1404
139.8	0.6729	0.0297	218.3	0.4544	0.1501

Saturated vapour pressure

t°	p mm	t°	p atm.	t°	p atm.
0	190	70	3.0	150	17.4
10	294	80	3.9	160	20.6
20	442	100	6.3	170	25.5
30	646	110	7.9	180	28.5
40	915	120	9.8	190	33.1
50	1267	130	12.0	200	35.8
60	1718	140	14.5	210	44.1
				220	50.4

Boiling point: 35°05 Hunter and Partington (1931)

Freezing point: −147°0 Timmermans

Density

t°	d		t°	d	
0	0.8623	Berthoud and Brum	38.7	0.8162	Berthoud and Brum
15.4	0.8454	„ (1924)	48.4	0.8043	„ (1924)
23.7	0.8357	„	78.4	0.7652	„
31.7	0.8259	„	20	0.8398	Hunter and Partington (1931)

Surface tension

t°	γ	
11.5	25.59	Berthoud and Brum (1924)
32.8	22.52	„
77.6	16.32	„

Refractive index

t°	$H\alpha$	D	$H\beta$	$H\gamma$	
19.8	1.42844	1.43146	1.43858	1.44469	Van Tussenbroek (1929)
20	--	1.43119	—	—	Hunter and Partington (1931)

DIMETHYL SULPHIDE $(CH_3)_2S$

Constants: Berthoud and Brum (1924)

Densities of the liquid and the saturated vapour

t°	L.	V.	t°	L.	V.
98.9	0.7490	0.0102	180.8	0.6081	0.0616
119.8	0.7210	0.0173	183.6	0.6011	0.0661
129.8	0.7066	0.0206	192.2	0.5796	0.0783
139.7	0.6897	0.0267	199.7	0.5601	0.0908
148.1	0.6758	0.0301	205.8	0.5403	0.1041
154.4	0.6641	0.0359	210.5	0.5251	0.1146
162.3	0.6484	0.0417	216.1	0.5037	0.1320
172.0	0.6266	0.0529	220.7	0.4833	0.1474

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
−22.557	52.46	4.933	210.33	14.872	326.37	Osborne, Doescher and Yost (1942)
−10.038	102.75	9.847	260.85	20.077	398.84	
+ 0.086	168.29					„

Boiling point

37°2	Strecker and Spitaler (1926)
37°33	Osborne, Doescher and Yost (1942)
37°4	Lecat

Melting point

−98°305	Osborne, Doescher and Yost (1942)

Density

t°	d	t°	d	t°	d
0	0.8720	43.3	0.8211	58.8	0.8023
15.8	0.8547	51.7	0.8108	60.0	0.8017
32.0	0.8347				

Surface tension

t°	γ	
11.1	26.50	Berthoud and Brum (1924)
32.9	23.33	„
57.7	19.87	„

Specific heat: Osborne, Doescher and Yost (1942) (M.W. 62.13)

t°	cp	t°	cp	t°	cp	t°	cp
C. −259.08	0.0142	−228.19	0.1084	−165.30	0.2345	L. −91.95	0.4330
−257.42	0.01811	−223.49	0.1216	−159.45	0.2425	−91.86	0.4328
−255.61	0.02302	−218.39	0.1349	−153.79	0.2499	−85.22	0.4325
−253.87	0.02805	−213.05	0.1472	−148.31	0.2572	−82.73	0.4320
−252.08	0.03378	−207.78	0.1596	−142.62	0.2648	−73.03	0.4320
−250.26	0.03951	−202.48	0.1708	−136.88	0.2720	−63.42	0.4324
−248.29	0.04592	−197.09	0.1822	−131.17	0.2794	−53.88	0.4328
−245.72	0.05410	−191.30	0.1930	−125.14	0.2870	−44.42	0.4341
−242.83	0.06393	−185.15	0.2036	−119.13	0.2952	−35.04	0.4355
−239.50	0.07468	−179.00	0.2139	−113.16	0.3026	−25.75	0.4375
−235.96	0.08558	−176.35	0.2179			−16.10	0.4400
−232.26	0.09665	−170.94	0.2258			− 6.10	0.4429
						+ 3.78	0.4462
						13.53	0.4499

Heat of vaporisation	(17°90 and 365.5 mm) 107.7 cal 15°/g	Osborne, Doescher and Yost (1942)
Heat of melting	30.73 „	„

DIETHYL SULPHIDE $(C_2H_5)_2S$

Constants: B.E. (1935)

Boiling point

92°10	$\frac{dt}{dp}$ *(10 mm):* 0°40 B.E. (1935) and Lecat
92°1	Beckmann (1878)

Freezing point: — 103°3

Density

t°	d	
0	0.85599	
15	0.84102	
30	0.82607	

Viscosity

t°	$\eta \cdot 10^5$	
15	467	
30	396	

Surface tension

t°	γ
15	25.78
20	25.28
30	24.16

Refractive index

t°	He r.	Hα	D	He y.	He g.	Hβ	He v.	
15	1.44208	1.44253	1.44550	1.44567	1.45118	1.45255	1.45699	B.E. (1935)
$\frac{dn}{dt}$	0.00051	51	—	51	51	51	52	„

Dielectric constant: 20° 6.004 Timmermans (unp.)

Vogel and Cowan (1943) give values for dimethyl and diethyl sulphides, which do not agree with those of the preceding authors; they have also studied a series of other sulphides.

TETRAMETHYL ORTHOTHIOCARBONATE $C(SCH_3)_4$

Constants: Backer and Perdok (1943)

Melting point: Form I 65°5 *Transition points:* Form III 23°2 Form II 45°5

Surface tension: 70° γ: 36

Refractive index

t°	Hα	D	Hβ	Hγ	
L. 70	1.5804	1.5853	1.5978	1.6085	

Heat of melting		4.942	cal 15°/g
Heat of transition	Form III → II	7.288	„
	Form II → I	9.085	„

ALLYL *iso*-THIOCYANATE $CH_2=CH.CH_2.N=C=S$

Constants: B.E. (1932)

Boiling point

152°0	$\frac{dt}{dp}$ *(10 mm)*: 0°50	
152°05	„ 0°50	LECAT

Freezing point

−102°5	TIMMERMANS

Density

t°	d	
0	1.03909	
15	1.02356	
30	1.00811	

Viscosity

t°	$\eta \cdot 10^5$	
15	782	
30	642	

Surface tension

t°	γ		t°	γ	
15	35.30		30	33.44	
20	34.66		11.5	35.82	SCHIFF (1883)

Refractive index

t°	He r.	Hα	He y.	He g.	Hβ	He v.
15	1.52731	1.52814	1.53349	1.54382	1.54645	1.55430
$\frac{dn}{dt}$	0.00053	53	53	54	55	55

MUSTARD GAS or YPERITE or ββ'-DICHLORODIETHYL SULPHIDE
$(CH_2Cl.CH_2)_2S$

Constants

Saturated vapour pressure

Dynam. method				*Stat. method*				
t°	p mm	t°	p mm	t°	p mm	t°	p mm	
14.9	0.046	41.8	0.392	17.8	0.057	63.2	1.64	Balson, Denbigh and Adam
19.7	0.070	47.6	0.611	25.0	0.100	65.3	2.07	,, (1947)
25.0	0.106	68.4	2.26	31.9	0.188	71.8	2.97	,,
30.1	0.163	75.8	3.52	40.0	0.350	74.3	3.39	,,
35.2	0.239			54.8	1.07	81.7	5.12	,,
								,,

t°	p mm	
30	0.1575	Bent and Francel (1948)
40	0.3363	,,
50	0.6822	,,

Melting point: 14°35 Balson, Denbigh and Adam (1947)
14°45 Felsing, Hunting and Fell (1948)

Refractive index: $n_D^{30°}$ 1.5227 Bent and Francel (1948)

CARBON OXYSULPHIDE COS

Constants: Clusius and Weigand (1940)

Melting curve

t°	p atm.	t°	p atm.	t°	p atm.
−138.68	12.93	−138.79	4.38	−138.85	0.001
−138.73	8.86				

Triple point: −138°85 and 0.001 atm.

METHYLSULPHOXIDE $(CH_3)_2SO$

Constants: DOUGLAS (1948)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm
20	0.417	35	1.195	45	2.27
25	0.600	40	1.656	50	3.07
30	0.853				

Heat of vaporisation: (25°) 191.3 cal 15°/g

METHANE and ETHANESULPHONIC ACIDS: SO_3HCH_3 and $SO_3HC_2H_5$: *Density, viscosity surface tension* and *refractive index:* BERTHOUD (1929).

DIALKYL SULPHITES and SULPHATES: R_2SO_3 and R_2SO_4 ($R=CH_3$ to C_5H_{11}): *Boiling point, density, surface tension* and *refractive index:* VOGEL and COWAN (1943).

TAURINE: $NH_2.(CH_2)_2.SO_3H$: *Specific heat:* HUFFMAN and FOX (1940).

$\beta.\beta'$-DITHIODILACTIC ACID: $(SCH(CH_3)CO_2H)_2$, CYSTEINE: HS $CH_2CH(NH_2)CO_2H$ and CYSTINE: $(CO_2H\ CH(NH_2)\ CH_2\ S)_2$: *Specific heat* and *heat of combustion:* HUFFMAN and ELLIS (1935) and BECKER and ROTH (1934).

THIOPHENOL C_6H_5 SH

Constants

Boiling point: 169°5 LECAT

Melting point: −14°9 PARKS, TODD and MOORE (1936)

Density

t°	d		t°	d	
25	1.0728	WALDEN and SWINNE	23.2	1.0739	EISENLOHR (1911)
50	1.0491	„ (1912)			
75	1.0254	„			

Surface tension

t°	γ		t°	γ	
16.9	39.19	WALDEN and SWINNE	58.0	34.10	WALDEN and SWINNE
23.5	38.34	„ (1912)	76.4	32.02	„ (1912)
35.0	36.89	„	93.5	30.32	„

Specific heat: Parks, Todd and Moore (1936)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. −183.16	0.1271	−123.16	0.1912	−63.16	0.2403	L. −13.16	0.3653
−173.16	0.1363	−113.16	0.1987	−53.16	0.2508	− 3.16	0.3699
−163.16	0.1488	−103.16	0.2061	−43.16	0.2622	+ 6.84	0.3745
−153.16	0.1691	− 93.16	0.2138	−33.16	0.2754	16.84	0.3792
−143.16	0.1831	− 83.16	0.2217	−23.16	0.305	26.84	0.3838
−133.16	0.1843	− 73.16	0.2306				

Heat of melting	2490 cal 15°/g	Parks, Todd and Moore (1936)

THIOPHEN C_4H_4S

Constants

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	
C. −80.96	0.007	L. −44.96	0.80	+0.04	21.3	Milazzo (1944)
−75.96	0.015	−35.16	1.98	5.24	28.5	,,
−67.66	0.050	−23.16	5.15	5.54	29.0	,,
−62.96	0.095	−12.96	9.5	13.54	44.0	,,
−60.16	0.140	− 6.56	14.5	16.24	49.5	,,
20.2	63.2	41.35	164.7	70.5	490	Nasini (1929)
25.05	79.8	50.6	243.4	79.9	641.5	,,
29.2	96.6	60.1	341	84.2	758.1	,,
71.0	500	81.45	700	89.7	900	Fawcett and Rasmus-
76.6	600	85.5	800			,, sen (1945)

Boiling point

84°0	Coulson, Hales and Herington (1948)	84°3	Nasini (1929)
		84°7	Lecat
84°12	Fawcet and Rasmussen (1945)	84°9	Eggers (1904)
84°3	Thorpe and Rodger (1894)		

$\frac{dt}{dp}$ *(10 mm)* 0°43 Fawcett and Rasmussen (1945)

Freezing point

−38°30	Fawcett and Rasmussen (1945)

Density

t°	d	t°	d	
11.8	1.07387	26.6	1.05662	Knops (1888)
16.5	1.06835	29.2	1.05332	"
19.7	1.06466	32.0	1.05034	"
23.4	1.06045			"
13.7	1.0711	34.1	1.04770	Nasini (1929)
15.4	1.06966	56.2	1.02090	"
30.3	1.0518			"
20	1.0644	30	1.0524	Fawcett and Rasmussen (1945)
25	1.0583			"
20	1.0647			Coulson, Hales and Herington (1948)

Viscosity

t°	$\eta \cdot 10^5$	t°	$\eta \cdot 10^5$	
20	662	30	584	Fawcett and Rasmussen (1945)
25	621			"

Refractive index

t°	Hα	t°	D	t°	Hβ	t°	Hγ	
16.3	1.525990	16.4	1.530777	16.3	1.543343	16.3	1.554216	Knops (1888)
20.2	1.523573	19.7	1.528736	20.1	1.540933	20.0	1.551859	"
25.5	1.520280	24.6	1.525582	25.3	1.537538	24.9	1.548110	"
28.2	1.518551	26.3	1.524454	27.6	1.536009	27.2	1.547186	"
$\frac{dn}{dt}$	0.000625		638		649		645	" (for other temperatures, see author)
—	—	20	1.5287	—	—	—	—	Fawcett and Rasmussen (1945)
—	—	25	1.5256	—	—	—	—	
—	—	30	1.5223	—	—	—	—	"
—	—	$\frac{dn}{dt}$	0.00044	—	—	—	—	"
—	—	20	1.5286	—	—	—	—	Coulson, Hales and Herington (1948)

		2-METHYLTHIOPHEN $C_4H_3(CH_3)\,S$		3-METHYLTHIOPHEN $C_4H_3(CH_3)\,S$	
Constants: Fawcett (1946)					
Boiling point		112°5		115°4	
$\frac{dt}{dp}$ *(10 mm)*		0°46		0°46	
Melting point		−63°5		A. −68°9 B. −74°1	
Density:	20°	1.0194		1.0216	
	25°	1.0140		1.0162	
	30°	1.0086		1.0110	
Viscosity: $\eta \cdot 10^5$	0°	944		902	
	20°	716		687	
	25°	669		642	
	30°	629		607	
Refractive index		n_D	$\frac{dn}{dt}$	n_D	$\frac{dn}{dt}$
	20°	1.5203		1.5204	
	25°	1.5174	0.00059	1.5175	0.00058
	30°	1.5144		1.5146	

2-ACETYLTHIOPHEN $C_4H_3\,(CH_3CO)\,S$

Constants: Johnson (1947)

Boiling point: 231°90 $\frac{dt}{dp}$ *(10 mm):* 0°55

Freezing point: 10°425

Density: 20° 1.1709

Viscosity $\eta \cdot 10^4$ 30° 232

Surface tension: 30° 44.5

Refractive index

t°	D	Hg gr.	Hg bl.	
20	1.5667	1.5727	1.6017	
$\frac{dn}{dt}$	0.00049	49	49	

2-NITROTHIOPHEN: $C_4H_3(NO_2)S$ and 2,5-DINITROTHIOPHEN: $C_4H_2(NO_2)_2S$: *Saturated vapour pressure* and *melting point:* Babasinian and Jackson (1929); *Melting point:* Steinkopf (1914) and Meyer and Stadler (1884).

14. DERIVATIVES WITH OTHER ELEMENTS

DIPHENYLSELENIDE: $(C_6H_5)_2$ Se: *Density, surface tension* and *refractive index:* Vogel and Cowan (1943).

CARBONSULPHOSELENIDE: CSSe: *Boiling point, density* and *surface tension:* Briscoe, Peel and Robinson (1929).

TRIETHYLPHOSPHINE: $(C_2H_5)_3P$: *Saturated vapour pressure:* Thompson and Linnett (1936); *density* and *refractive index:* Jones, Davies and Dyke (1933). Other PHOSPHINES and other PHOSPHORUS-CONTAINING COMPOUNDS: Jones, Davies and Dyke (1933).

TRIPHENYLPHOSPHINE: $(C_6H_5)_3P$: *Saturated vapour pressure, melting point, density* and *surface tension*: Forward, Bowden and Jones (1949)

A series of ORTHOPHOSPHATES: $PO_4R_3(R{=}CH_3{\rightarrow}C_5H_{11})$ Vogel and Cowan (1943).

2-CHLOROVINYLDICHLOROARSINE: $(CH_2{=}CCl)Cl_2$ As *cis*: *Saturated vapour pressure, boiling* and *melting points, density, viscosity* and *refractive index:* Whiting (1948).

DIPHENYLCYANOARSINE: $(C_6H_5)_2CN$ As: *Saturated vapour pressure*: Balson (1947)

TRIPHENYLARSINE, STIBINE and BISMUTHINE: $(C_6H_5)_3As$; $(C_6H_5)_3Sb$; $(C_6H_5)_3Bi$: *Saturated vapour pressure, melting point, density* and *surface tension*: Forward, Bowden and Jones (1949)

TETRAMETHYLSILANE $(CH_3)_4$ Si

Constants: Aston, Kennedy and Messerly (1941)

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm
−64.22	6.24	−23.11	90.79	+1.41	289.35	15.25	503.41
−55.98	11.71	−17.08	123.78	8.83	392.31	19.46	588.54
−36.99	41.50	− 9.43	178.77	9.79	407.57	20.49	611.29
−30.31	61.28	− 3.97	229.12	14.81	494.99		

Boiling point *Freezing point*

26°64		(α)	unst. form	−102°12	(β)	st. form	−99°04

Specific heat (M.W. 88.197)

t°	c_p	t°	c_p	t°	c_p	t°	c_p
C. β −260.87	0.00990	−209.11	0.16995	· −127.94	0.3298	−63.81	0.4649
−258.77	0.01663	−204.00	0.18219	−121.43	0.3417	−58.94	0.4683
−256.73	0.02305	−199.15	0.19429	−115.03	0.3548	−53.34	0.4723
−254.90	0.02808	−194.16	0.20689	−108.99	0.3654	−47.65	0.4753
−253.12	0.03531	−188.77	0.21874	−104.51	0.3935	−42.33	0.4787
−251.38	0.04186	−183.36	0.22911	−101.76	0.4609	−36.75	0.4842
−248.98	0.04774	−178.11	0.24053	C. α −105.54	0.4196	−30.61	0.4854
−245.28	0.06114	−172.72	0.2516	−104.69	0.4621	−22.66	0.4932
−240.32	0.07764	−167.03	0.2633	−103.98	0.5396	−16.83	0.4962
−236.04	0.09043	−161.25	0.2730	L. − 94.75	0.4456	−10.33	0.5016
−231.89	0.1022	−155.80	0.2814	− 90.04	0.4486	− 3.39	0.5070
−226.95	0.11673	−150.73	0.2870	− 84.26	0.4544	+ 3.01	0.5138
−222.02	0.13390	−145.47	0.3003	− 78.66	0.4564	9.35	0.5200
−216.87	0.14584	−140.01	0.3098	− 74.32	0.4589	15.24	0.5329
−215.47	0.15056	−134.00	0.3196	− 67.21	0.4645	20.37	0.5485
−211.62	0.16166						

Heat of vaporisation	26°64	65.59	cal 15°/g	
Heat of melting	α	16.177	„	
	β	18.643	„	

METHYL CHLORO, METHYL FLUORO, METHYL CHLOROFLUOROSILANES: $(CH_3)_2Cl_2Si$, CH_3Cl_3Si, CH_3F_3Si, CH_3ClF_2Si and CH_3Cl_2FSi:
Saturated vapour pressure, boiling and melting point, heat of vaporisation: Booth and Martin (1946); *density:* Balis, Gilliam, Hadsell, Liebhafsky and Winslow (1948).

ETHYL ORTHOSILICATE $Si\,(O\,C_2H_5)_4$

Constants: Solana and Moles (1932)

Critical temperature: 611°

Saturated vapour pressure

t°	p mm	t°	p mm	t°	p mm	t°	p mm
24.8	2.8	114.2	148.5	138.6	328.3	165.3	701.3
39.5	6.1	121.0	183.3	141.7	358.6	165.8	708.2
60.1	18.0	122.3	191.1	146.2	407.5	168.2	754.0
66.0	21.6	123.5	202.0	149.0	449.0	170.2	794.0
80.6	41.8	124.7	211.3	153.5	511.6	171.5	812.8
82.8	45.4	128.5	231.1	157.3	560.9	172.8	849.8
93.1	66.4	130.7	249.0	162.9	653.5	173.2	863.6
107.2	109.6	132.6	270.0				

Boiling point *Melting point*

168°55		−82°5	
168°8	Lecat		

Density and viscosity

t°	d	$\eta \cdot 10^4$	t°	d	$\eta \cdot 10^4$	t°	d	$\eta \cdot 10^4$
0	0.95558	—	25	0.92939	6556	50	0.90192	4972
5	0.95028	—	30	0.92384	6161	58	0.89307	4579
10	0.94485	7926	35	0.91840	5812	66	0.88446	4273
15	0.93964	7395	40	0.91295	5507	73	0.87730	4056
20	0.93456	6939	45	0.90741	5216			

Refractive index

$n_D^{16°}$	1.38169	

Constants:	METHYLBORIC ANHYDRIDE $(CH_3BO)_3$				METHYLBORIC ACID $CH_3B(OH)_2$			
BURG (1940)	t°	p mm	t°	p mm	t°	p mm	t°	p mm
Saturated vapour pressure	L. 0.0	20.5	32.2	113.0	C. 25	2.5	57	31
	14.3	46.5	39.9	161.5	31	4.2	61	42
	21.7	67.8	47.7	227.1	41	9.3	65	55
	24.8	79.2	54.8	304.7	45	13.0		
Boiling point	79°				—			
Melting point	−38°				—			

Constants:	METHYLBORODIFLUORIDE BCH_3F_2				DIMETHYLBOROFLUORIDE $B(CH_3)_2F$			
BURG (1940)	t°	p mm	t°	p mm	t°	p mm	t°	p mm
Saturated vapour pressure	−98.6	62.4	−80.9	242.7	−112	6.0	−78.7	93.06
	−95.7	80.0	−78.7	281.8	−96.0	25.2	−64.5	230.1
	−94.2	90.0	−69.0	524	−84.6	61.0	−45.9	633
	−91.1	116.4	−64.3	681				
	−85.9	170.6						
Boiling point	− 62°3				−42°2			
Melting point	−130°45				−147°35			

METHYL and ETHYL BORATES: $B(OCH_3)_3$ and $B(OC_2H_5)_3$: *Boiling point, density* and *surface tension:* ETRIDGE and SUGDEN (1928); *boiling point:* LECAT.

15. ADDENDA

We have become acquainted with the following works too late to include them in the tables:

Carley and Bertelsen (1949): Carbon tetrachloride

D'Hondt and Jungers (1949): 1,1-Dibromoethane and 1,1,2-Tribromoethane

Dreisbach and Shrader (1949) and Dreisbach and Martin (1949): Carbon tetrachloride, 1,2-Dichloropropane, *n*-Butyl bromide and *o*-Dichlorobenzene

A. F. Forziati, W. R. Norris and F. D. Rossini, J. Research Nat. Bur. Standards, 43, 555 (1949): vapour pressures and boiling points of paraffins in C_7 and C_9, alkyl*cyclo*pentanes, alkyl*cyclo*hexanes and alkylbenzenes

A. F. Forziati and F. D. Rossini, J. Research Nat. Bur. Standards, 43, 473 (1949) give some constants of many hydrocarbons. The agreement with values given in this book is usually very good; the only discrepancies occur for 1,2,3-Trimethylbenzene (hemimellitene), 1,2,4-Trimethylbenzene (*pseudo*-Cumene) and Ethyl*cyclo*pentane.

Nicolini and Laffite (1949): Methyl*cyclo*hexane, Di*iso*propyl ether, Dimethylacetal, Diethylacetal, Dimethylformal, Diethylformal

Seyer, Bennett and Williams (1949): Hexamethylethane

Steinhauser and White (1949): *n*-Heptane, Benzene and Toluene

Waddington, Smith, Scott and Huffman (1949): 2-Methylpentane and 2,3-Dimethylbutane (cf. Howard, Mears, etc. (1947), see p. 645, and Forziati, Glasgow, Jr., etc. (1946), see p. 641).

Corrigenda

Von Grosse, see Grosse
Halban, see Von Halban
Kolossowski, see De Kolossowski
Lee, see Van der Lee
Narbutt, see Von Narbutt
Reis, see Von Reis
Schneider, see Von Schneider

p. 98, density of *n*-Nonane, the value 0.71328 should read 0.71398.

p. 127, in the last columns of the first table, (work of Scott, Waddington, etc.) the pressure in mm should be replaced as follows:

t°	p mm
46.728	1268.0
52.005	1489.3
57.320	1740.9
62.675	2025.8

N.B. The pressures in mm indicated by the same authors for Pentene (p. 124) and the 2-Methylbutenes (p. 127 and 128) are not exactly equal, but differ by some hundredths of a mm.

p. 139, under the table of the specific heats of Butyne-2, Between 130° and 110° should read: Between −130° and −110°.

p. 272, for *sec.* Hexyl fluoride, the surface tension is 20.39 and not —. The refractive index is measured at 20° and not at 20°39.

BIBLIOGRAPHY

1. HISTORICAL

The honour of having undertaken the first systematic investigation on the physical constants of pure organic compounds belongs to KOPP (1842).

For a long time afterwards, there were but few chemists who carried out research of this nature. During about half a century, only the classical works of MENDELEEF on ethyl alcohol, of DE VISSER on acetic acid, and of REGNAULT, were outstanding. This state of affairs lasted until the study of stoichiometric relations made necessary the preparation of a large number of organic compounds in a state of purity, and the precise determination of their constants.

An early group of investigators undertook such a systematic research about 1885; in particular may be mentioned LOSSEN and GARTENMEISTER, of the laboratory of Konigsberg, who continued and extended the determinations of KOPP on molecular volumes.

They were followed by BRÜHL, whose determinations of refractive indices are classic; SCHIFF made an important contribution to the study of capillary constants; THORPE, the first good measurements of viscosity; and PERKIN those of the magnetic rotatory power of organic compounds. All these scientists paid special attention to the purification of their samples and, in many cases, their results have been confirmed by contemporary authors.

At about the same time S. YOUNG, at first in collaboration with RAMSAY, and later alone, undertook his magnificent series of researches on the experimental control of the equation of state of pure fluids; in this work he studied some thirty organic compounds which were purified with extreme care, and made use of the constancy of the isothermal saturated vapour pressure as an exceptionally sensitive criterion of purity. These researches, which made their author famous, extended over the whole of his scientific career, and may be considered as a model for this type of long and careful work.

Since the beginning of the present century, the study of these problems has been taken up in a large number of laboratories, and among the noteworthy results obtained there should be mentioned those of EYKMAN for the measurements of refractive indices and of PICKARD and KENYON for rotatory power; further reference may also be made to the work of PARKS and that of ANDREWS on specific heats and heats of transformation; finally, among contemporary authors, LOWRY (simple and rotatory dispersion), SWIETOSLAWSKI, KEFFLER and VERKADE (heats of combustion).

The study of the constants of pure gases forms a special sphere reserved to a few well-known centres of research: LEDUC and KUENEN played the part of pioneers in this direction; the most important investigations have been carried out by KAMERLINGH ONNES and his collaborators at the Cryogenic laboratory at Leyden, and later also by MICHELS at the laboratory of VAN DER WAALS in Amsterdam; another school is that of PH. A. GUYE of Geneva which includes in addition to its founder, BAUME, CARDOSO, and MOLES; the latter has brilliantly carried on the traditions of his master at Madrid. During the last fifteen years CLUSIUS, at Munich, has also made some notable investigations on the properties of gases.

Only the great national laboratories of different countries possess the resources and the staff necessary for certain long-term projects; they have accordingly played an important part in the study of pure compounds. In the realm of organic compounds, the National Bureau of Standards at Washington is specially distinguished by the researches of DICKINSON on the heat of combustion, those of BURGESS on thermometric standards, and by the work of WASHBURN on the separation, in a state of purity, of the hydrocarbons of petroleum. In Russia, the Institute of Pure Reagents of the U.S.S.R., under the direction of LONGINOFF has carried on the tradition of MENDELEEF by the study of anhydrous alcohols, completing the great work devoted to ethyl alcohol by OSBORNE and MACKELVY (National Bureau of Standards of Washington).

For some forty years the Belgian chemical school has attached great importance to the study of very pure organic compounds, and this favourable environment has undoubtedly contributed to the establishment of the International Bureau of Physico-chemical Standards at Brussels, where the usual constants of nearly two hundred organic compounds—those most frequently used in physico-chemical works—have been studied. Further evidence of the same tendency is given by the interest shown in these problems by organic chemists who, in Belgium, co-operate with the physico-chemists. Following the classical work of CRISMER on anhydrous alcohols, there should be mentioned the researches carried out by SWARTS at Ghent (refractive indices and heats of combustion of fluorine compounds), by CHAVANNE at Brussels (hydrocarbons of petroleum and *cis-trans* halogenated derivatives), and finally those of BRUYLANTS at Louvain (densities and refractive indices in the homologous series of paraffins, nitriles, etc.).

The importance of this work has received particular recognition from the International Union of Pure and Applied Chemistry, of which several permanent commissions are devoted to this type of study; outside the International Bureau of Physico-chemical Standards mention may be made in particular of the publications of the Committee of Thermochemistry and those of the New Committee of Physico-chemical Data; Swietoslawski, who has presided successively over these two committees, is notable for his personal researches, of great importance, on the heat of combustion of organic compounds; and the ebulliometric, cryometric and calorimetric methods which he has perfected during recent years will become the starting point for an important advance in the development of this branch of science.

The contributions of the American school during the last war were very important and valuable. At the National Bureau of Standards, Rossini and his colleagues, working in collaboration with the American Petroleum Institute, carried out an important work on the hydrocarbons of which the chief results are collected in their "Selected Values of Properties of Hydrocarbons" (1946–1949). We could not always take into account these numerical data, as they were abstracted from unpublished work, of unknown accuracy. Moreover a large number of U.S. university laboratories have studied the variation of entropy as a function of temperature, for a number of organic compounds; in particular Aston in Pennsylvania and Giauque in California were very fortunate in this field.

Reviewing the bulk of the publications on the subject of the present work, one cannot help being struck by the great inequality in the part taken by different nations in the study of the problem of pure organic compounds; certainly it appears that this type of research hardly succeeds in retaining the attention of French and German chemists. It is curious on the other hand, to note how the Anglo-Saxon physico-chemists have distinguished themselves in this sphere for a long time. Already in 1794, Cavendish had measured, with remarkable accuracy for his time, the constants of the gases which he was studying; later Faraday in his turn took up this kind of work.

Since then, this predilection of English and American chemists has continued, and the development, in Belgium, of a school of research in this particular branch of science is, to some extent, the result of the indirect influence of S. Young; while important American publications are due to Calingaert and Henne, former pupils of Brussels University.

N.B. — The references have been collected till the beginning of 1950.

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Unless otherwise indicated, all compounds in which the possibility of structural isomerism arises, are assumed to be the normal (*n*-) isomerides.

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$C_6H_5F_2N$ 2,5-Difluoroaniline, 606
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$C_6H_5ClO_2$ Monochloroquinol, 515
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$C_6H_5NO_3$ *o*-Nitrophenol, 598
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$C_6H_{10}O_3$ Propionic anhydride, 376
$C_6H_{10}O_4$ Adipic acid, 404
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— Ethylene glycol diacetate, 444
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— Methyl methylmalonate, 452
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$C_6H_{10}O_6$ Methyl tartrate, 453
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$C_6H_{11}BrO_2$ Ethyl bromobutyrate, 514
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$C_6H_{11}N$ Capronitrile, 535
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$C_6H_{11}NO$ Hexene(2)amide, 585, 586, 587
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— Cyclohexanol, 491
— Methylbutylketone, 362
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— *tert.*Butylacetic acid, 394
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— 3-Methylpentanol-3, 331
$C_6H_{14}O_2$ 1,1-Diethoxyethane, 628
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$C_6H_{14}O_3S$ Dipropyl sulphite, 621
$C_6H_{14}O_4S$ Dipropyl sulphate, 621
$C_6H_{14}O_6$ Mannitol, 338
$C_6H_{15}N$ Dipropylamine, 524

$C_6H_{15}N$ Hexylamine, 524
— Triethylamine, 523
$C_6H_{15}O_3B$ Triethyl borate, 627
$C_6H_{15}O_4P$ Triethyl orthophosphate, 625
$C_6H_{15}P$ Triethylphosphine, 625

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— Perfluorodimethylcyclopentane, 301
— Perfluoroethylcyclopentane, 301
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— *o*-Chlorobenzoyl chloride, 516
— *p*-Chlorobenzoyl chloride, 516
$C_7H_5F_3$ Benzotrifluoride, 295
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$C_7H_5ClO_2$ *m*-Chlorobenzoic acid, 515
— *o*-Chlorobenzoic acid, 515
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$C_7H_5Cl_3$ Benzotrichloride, 296
— Phenylchloroform, 296
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C_7H_5N Benzonitrile, 566
$C_7H_5NO_4$ *m*-Nitrobenzoic acid, 601
— *p*-Nitrobenzoic acid, 601
$C_7H_5N_3O_6$ 2,4,6-Trinitrotoluene, 597
$C_7H_6N_2O_5$ Dinitro-*o*-cresols, 600
C_7H_6O Benzaldehyde, 474
$C_7H_6O_2$ Benzoic acid, 480
$C_7H_6O_3$ Gallic acid, 482
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C_7H_7F *m*-Fluorotoluene, 294
— *o*-Fluorotoluene, 294
— *p*-Fluorotoluene, 294
C_7H_7Cl Benzyl chloride, 295
— *m*-Chlorotoluene, 297
— *o*-Chlorotoluene, 297
— *p*-Chlorotoluene, 297
C_7H_7Br *m*-Bromotoluene, 297
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C_7H_7NO Benzamide, 589
— Formanilide, 589
$C_7H_7NO_2$ *m*-Aminobenzoic acid, 589
— *o*-Aminobenzoic acid, 589
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— *m*-Nitrotoluene, 595
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$C_7H_7NO_2$ Salicylamide, 589
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C_7H_8 Toluene, 150, 628
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— *p*-Cresol, 465
$C_7H_8O_2$ *m*-Methoxyphenol, 472
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C_7H_9N Methylaniline, 554
— *m*-Toluidine, 560
— *o*-Toluidine, 558
— *p*-Toluidine, 561
$C_7H_{10}N_2$ 1-Methyl-2-phenylhydrazine, 565
— Pentamethylene dicyanide, 550
— Pimelonitrile, 550
$C_7H_{10}O_4$ Methyl citraconate, 456
— Methylcyclopropane-1,1-dicarboxylate, 498
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$C_7H_{11}F_3$ Cyclohexylfluoroform, 301
— Cyclohexyltrifluoromethane, 301
— Trifluoromethylcyclohexane, 301
$C_7H_{11}N$ Cyclohexylcyanide, 568
— Heptene(6)nitrile, 546
C_7H_{12} 1,2-Dimethylcyclopentene, 192
— 1,5-Dimethylcyclopentene, 192
— Heptyne-1, 140
$C_7H_{12}ClN$ α-Chloroheptanenitrile, 603
— α-Chlorooenanthonitrile, 603
$C_7H_{12}O$ 2-Methylcyclohexanone, 494
— 3-Methylcyclohexanone, 494
— 4-Methylcyclohexanone, 494
$C_7H_{12}O_2$ Hepten(6)oic acid, 404
— Propyl crotonate, 453
— *iso*Propyl crotonate, 453
$C_7H_{12}O_4$ Dimethylglutaric acid, 404
— Ethyl malonate, 449
— Methyl dimethylmalonate, 452
— Methyl ethylmalonate, 452
— Pimelic acid, 404
$C_7H_{13}ClO$ Heptanoyl chloride, 511
— Oenanthoyl chloride, 511
$C_7H_{13}N$ Heptanenitrile, 536
— 2-Methylcapronitrile, 541
— Oenanthonitrile, 536
$C_7H_{13}NO$ Heptene(2)amide, 585, 586, 587
C_7H_{14} 1,1-Dimethylcyclopentane, 191
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C_7H_{14} 3-Ethylpentene-2, 134
— Heptene-1, 132
— Methylcyclohexane, 197
— 2,3,3-Trimethylbutene-1, 133
$C_7H_{14}O$ Butylvinylcarbinol, 334
— Dimethylcyclopentanol, 490
— Dipropylketone, 358
— Ethylbutylketone, 364
— Heptyl aldehyde, 353
— Methylamylketone, 364
— Oenanthal, 353
$C_7H_{14}O_2$ Amyl acetate, 419
— Butyl propionate, 425
— *sec.*Butyl propionate, 426
— Ethyl trimethylacetate, 435
— Ethyl valerate, 435
— Heptanoic acid, 395
— Hexyl formate, 412
— Methyl caproate, 435
— Oenanthic acid, 395
— Propyl butyrate, 429
— Propyl *iso*butyrate, 433
— *iso*Propyl butyrate, 429
— *iso*Propyl *iso*butyrate, 433
— *iso*Butyl propionate, 425
$C_7H_{14}O_3$ *iso*Butyl lactate, 452
— *sec.*Butyl lactate, 452
— *tert.*Butyl lactate, 452
$C_7H_{15}F$ Heptyl fluoride, 273
$C_7H_{15}Cl$ 2-Chloroheptane, 273
— 3-Chloroheptane, 273
— 4-Chloroheptane, 273
— Heptyl chloride, 273
$C_7H_{15}Br$ 2-Bromoheptane, 273
— 3-Bromoheptane, 273
— 4-Bromoheptane, 273
— Heptyl bromide, 274
$C_7H_{15}I$ Heptyl iodide, 274
$C_7H_{15}NO$ Oenanthamide, 584, 586, 587
C_7H_{16} Dimethyldiethylmethane, 78
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— 2,3-Dimethylpentane, 74
— 2,4-Dimethylpentane, 76
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— Di*iso*propylmethane, 76
— 3-Ethylpentane, 70
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— Methylethyl*iso*propylmethane, 74
— 2-Methylhexane, 66
— 3-Methylhexane, 68
— Triethylmethane, 70
— 2,2,3-Trimethylbutane, 80
— Trimethyl-*iso*-propylmethane, 80
$C_7H_{16}O$ Heptyl alcohol, 331
$C_7H_{17}N$ Heptylamine, 524

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C_8F_{16} Perfluoro-*m*-dimethylcyclohexane, 301
— Perfluoro-*o*-dimethylcyclohexane, 301
— Perfluoro-*p*-dimethylcyclohexane, 301
$C_8H_6ClNO_3$ *m*-Nitrochloroacetophenone, 609
— *o*-Nitrochloroacetophenone, 609
C_8H_6BrN Bromobenzylcyanide, 604
$C_8H_6N_2$ Quinoxaline, 574
$C_8H_6O_4$ Phthalic acid, 482
— Terephthalic acid, 482
C_8H_7ClO Chloroacetophenone, 515
C_8H_8 Cyclooctatetraene, 207
C_8H_8O Acetophenone, 475
$C_8H_8O_2$ Methyl benzoate, 482
— *p*-Xyloquinone, 475
$C_8H_8O_3$ Methyl salicylate, 487
C_8H_9FO *m*-Fluorophenetole, 514
— *o*-Fluorophenetole, 514
— *p*-Fluorophenetole, 514
C_8H_9NO Acetanilide, 589
— Phenylacetamide, 589
$C_8H_9NO_2$ Hydroxyacetanilide, 589
C_8H_{10} Ethylbenzene, 154
— *m*-Xylene, 164
— *o*-Xylene, 161
— *p*-Xylene, 166
$C_8H_{10}N_4O_7$ Ethylammonium picrate, 597
$C_8H_{10}O$ Phenetole, 470
$C_8H_{10}O_2$ Creosol, 472
— *m*-Dimethoxybenzene, 472
— *o*-Dimethoxybenzene, 471
— *p*-Dimethoxybenzene, 472
— 2-Methoxy-4-methylphenol, 472
— Veratrole, 471
— *p*-Xyloquinol, 469
$C_8H_{11}N$ Dimethylaniline, 555
— Ethylaniline, 556
— *m*-Xylidine, 563
$C_8H_{12}Cl_2O_4$ Ethyl dichlorosuccinate, 514
$C_8H_{12}O_4$ Ethyl fumarate, 455
$C_8H_{13}N$ Octene(7)nitrile, 546
C_8H_{14} 1,4-Dimethylcyclohexene, 207
$C_8H_{14}ClN$ α-Chlorocaprylonitrile, 603
— α-Chlorooctanenitrile, 603
$C_8H_{14}O_2$ Butyl crotonate, 453
— *iso*Butyl crotonate, 453
— *sec.*Butyl crotonate, 453
— 2-Ethyl-3-propylacrylic acid, 404
— 2-Methyl-3-ethylpenten(3)oic acid, 404
— 3-Propyl-2-ethylacrylic acid, 404
$C_8H_{14}O_4$ Ethyl succinate, 450

$C_8H_{14}O_4$ Methyl methylethylmalonate, 452
— Methyl propylmalonate, 452
— Suberic acid, 404
$C_8H_{14}O_5$ Ethyl malate, 453
$C_8H_{14}O_6$ Ethyl tartrate, 453
— Ethyl *meso*tartrate, 453
$C_8H_{15}ClO$ Capryloyl chloride, 511
— Octoyl chloride, 511
$C_8H_{15}N$ Caprylonitrile, 537
— 2-Methylheptanenitrile, 542
— 2-Methyloenanthonitrile, 542
— Octanenitrile, 537
$C_8H_{15}NO$ Octene(2)amide, 585, 586, 587
C_8H_{16} 1,1-Dimethylcyclohexane, 201
— 1,2-Dimethylcyclohexane, 201
— 1,3-Dimethylcyclohexane, 204
— 1,4-Dimethylcyclohexane, 204
— Ethylcyclohexane, 201
— 6-Methylheptene-1, 134
— Propylcyclopentane, 190
$C_8H_{16}N_2O_3$ Leucylglycine, 587
$C_8H_{16}O$ 1,2-Dimethylcyclohexanol-1, 492
— 1,3-Dimethylcyclohexanol-1, 492
— 1,4-Dimethylcyclohexanol-1, 492
— Ethylamylketone, 364
— Methylhexylketone, 362
— Propylbutylketone, 364
— 2,2,4-Trimethylpentanone-3, 365
$C_8H_{16}O_2$ Amyl propionate, 425
— *sec.*Amyl propionate, 426
— Butyl butyrate, 429
— *iso*Butyl butyrate, 429
— *iso*Butyl *iso*butyrate, 433
— *sec.*Butyl butyrate, 430
— Caprylic acid, 396
— Ethyl caproate, 436
— Heptyl formate, 412
— Hexyl acetate, 420
— *sec.*Hexyl acetate, 420
— Methyl oenanthate, 439
— Propyl valerate, 435
$C_8H_{17}F$ Octyl fluoride, 275
$C_8H_{17}Cl$ 2-Chloro-2,3,3-trimethylpentane, 275
$C_8H_{17}Br$ Octyl bromide, 275
$C_8H_{17}I$ Octyl iodide, 275
$C_8H_{17}NO$ Caprylamide, 584, 586, 587
C_8H_{18} Bi*iso*butyl, 89
— 2,3-Dimethylhexane, 89
— 2,4-Dimethylhexane, 89
— 2,5-Dimethylhexane, 89
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C_8H_{18} 2-Methyl-3-ethylpentane, 95
— 2-Methylheptane, 89
— 3-Methylheptane, 88
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— "*iso*Octane", see 2,2,4-Trimethylpentane
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— 2,2,3-Trimethylpentane, 91
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— 2,3,3-Trimethylpentane, 95
— 2,3,4-Trimethylpentane, 95
$C_8H_{18}O$ Dibutyl ether, 347
— Methylhexylcarbinol, 331
— Octyl alcohol, 331
— Octyl alcohols, 331
— *sec.*Octyl alcohol, 331
— *tert.*Octyl alcohol, 332
$C_8H_{18}O_3S$ Dibutyl sulphite, 621
$C_8H_{18}O_4S$ Dibutyl sulphate, 621
$C_8H_{19}N$ Dibutylamine, 524
— Octylamine, 524
$C_8H_{20}O_4Si$ Ethyl orthosilicate, 626

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C_9F_{16} Perfluorohexahydroindane, 301
C_9F_{18} Perfluoro-1,3,5-trimethylcyclohexane, 301
C_9H_7N Quinoline, 572
— *iso*Quinoline, 571
$C_9H_9NO_3$ Hippuric acid, 587
$C_9H_{10}O_2$ *m*-Cresyl acetate, 482
— Ethyl benzoate, 484
$C_9H_{10}O_3$ Methyl mandelate, 486
— Methyl phenylglycolate, 486
$C_9H_{11}N$ Tetrahydroquinoline, 574
$C_9H_{11}NO$ Methylacetanilide, 589
$C_9H_{11}NO_2$ Ethyl carbanilate, 589
— N-Phenylurethan, 589
$C_9H_{11}NO_3$ Tyrosine, 587
C_9H_{12} *pseudo*Cumene, 170, 628
— Hemimellitene, 171, 628
— Mesitylene, 170
— Propylbenzene, 157
— *iso*Propylbenzene, 158
— 1,2,3-Trimethylbenzene, 171, 628
— 1,2,4-Trimethylbenzene, 170, 628
— 1,3,5-Trimethylbenzene, 170
$C_9H_{12}O$ Phenylethylcarbinol, 458
— Phenylpropyl ether, 471
$C_9H_{12}O_2$ 4-Propylpyrocatechol, 469
$C_9H_{13}N$ Dimethyl-*o*-toluidine, 563
— Dimethyl-*p*-toluidine, 563
$C_9H_{14}O_3$ Methylcyclopentanone ethyl carboxylate, 490

$C_9H_{16}ClN$ α-Chlorononanenitrile, 603
— α-Chloropelargonitrile, 603
$C_9H_{16}O_2$ *iso*Amyl crotonate, 453
$C_9H_{16}O_4$ Azelaic acid, 404
— Ethyl glutarate, 451
— Methyl methylpropylmalonate, 452
— Methyl pimelate, 452
— Propyl malonate, 452
$C_9H_{17}ClO$ Nonoyl chloride, 511
— Pelargoyl chloride, 511
$C_9H_{17}N$ 2-Methylcaprylonitrile, 542
— 2-Methyloctanenitrile, 542
— Nonanenitrile, 538
— Pelargonitrile, 538
$C_9H_{17}NO$ Nonene(2)amide, 585, 586, 587
C_9H_{18} Butylcyclopentane, 190
— *iso*Propylcyclohexane, 200
$C_9H_{18}O$ Dibutylketone, 358
— Di*iso*butylketone, 359
— Diethylcyclopentanol, 490
— Methylheptylketone, 362
— Methylpropylcyclopentanol, 490
— 2,2,4,4-Tetramethylpentanone-3, 365
$C_9H_{18}O_2$ Amyl *iso*butyrate, 433
— *sec.*Amyl butyrate, 430
— *sec.*Butyl valerate, 435
— Ethyl oenanthate, 438
— Heptyl acetate, 420
— *sec.*Heptyl acetate, 420
— Hexyl propionate, 426
— *sec.*Hexyl propionate, 426
— Methyl caprylate, 442
— Nonoic acid, 397
— Octyl formate, 412
— *sec.β*-Octyl formate, 412
— Pelargonic acid, 397
— Propyl caproate, 436
$C_9H_{19}NO$ Pelargonamide, 584, 587
C_9H_{20} 3,3-Diethylpentane, 101
— 2,2-Dimethyl-3-ethylpentane, 101
— 2,4-Dimethyl-3-ethylpentane, 101
— 2,5-Dimethylheptane, 99
— 2,6-Dimethylheptane, 100
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— 2,2,4-Trimethylhexane, 101
— 2,2,5-Trimethylhexane, 101
C_9H_{20} 2,3,5-Trimethylhexane, 101
$C_9H_{20}O$ Di*iso*butylcarbinol, 332
— Methyloctanols, 332
— Methyl *sec.*octyl ether, 350
— Nonyl alcohols, 332
— *tert.*Nonyl alcohol, 332
$C_9H_{21}N$ Nonylamine, 524
$C_9H_{21}O_4P$ Tripropyl orthophosphate, 625

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$C_{10}H_5N_3O_6$ 1,3,8-Trinitronaphthalene, 597
— 1,4,5-Trinitronaphthalene, 597
$C_{10}H_6N_2O_4$ 1,5-Dinitronaphthalene, 597
— 1,8-Dinitronaphthalene, 597
$C_{10}H_7Br$ α-Bromonaphthalene, 300
$C_{10}H_7NO_2$ α-Nitronaphthalene, 597
$C_{10}H_8$ Naphthalene, 177
$C_{10}H_9N$ 2-Methylquinoline, 574
— Quinaldine, 574
$C_{10}H_{10}O$ Benzylideneacetone, 479
$C_{10}H_{10}O_2$ Benzoylacetone, 479
— Safrole, 473
— *iso*Safrole, 473
$C_{10}H_{11}ClO_2$ Ethyl phenylchloroacetate, 516
$C_{10}H_{12}$ 1,2,3,4-Tetrahydronaphthalene, 208
— Tetralin, 208
$C_{10}H_{12}O$ Anethole, 471
— *p*-Propenylanisole, 471
$C_{10}H_{12}O_2$ Eugenol, 472
$C_{10}H_{12}O_3$ Ethyl mandelate, 486
— Ethyl *o*-methoxybenzoate, 488
— Ethyl methylsalicylate, 488
— Ethyl phenylglycolate, 486
$C_{10}H_{13}NO$ Ethylacetanilide, 589
$C_{10}H_{14}$ Butylbenzene, 159
— *iso*Butylbenzene, 160
— *sec.*Butylbenzene, 160
— *tert.*Butylbenzene, 160
— Diethylbenzenes, 173
— 1,3-Dimethyl-4-ethylbenzene, 173
— 1,3-Dimethyl-5-ethylbenzene, 173
— Durene, 172
— *iso*Durene, 172
— 1-Methyl-2-*iso*propylbenzene, 173
— 1-Methyl-3-*iso*propylbenzene, 173
— Prehnitene, 172
— 1,2,3,4-Tetramethylbenzene, 172
— 1,2,3,5-Tetramethylbenzene, 172
— 1,2,4,5-Tetramethylbenzene, 172
$C_{10}H_{14}N_2$ Anabasine, 576
— Nicotine, 575
$C_{10}H_{14}N_4O_7$ *iso*Butylammonium picrate, 597
— Diethylammonium picrate, 597
$C_{10}H_{14}O$ Carvacrol, 466

$C_{10}H_{14}O$ Carvone, 498
— 2-Methyl-5-*iso*propylphenol, 466
— 3-Methyl-4-*iso*propylphenol, 467
— 5-Methyl-2-*iso*propylphenol, 466
— Phenylbutyl ether, 471
— Phenylpropylcarbinol, 458
— Thymol, 466
— *p*-Thymol, 467
$C_{10}H_{15}N$ Diethylaniline, 557
$C_{10}H_{16}$ α-Pinene, 209
— β-Pinene, 209
$C_{10}H_{16}O$ Camphor, 497
— Carvenone, 498
— Dihydrocarvone, 498
— Dihydroeucarvone, 498
— Pulegone, 498
$C_{10}H_{18}$ Decahydronaphthalene, 209
— Decalin, 209
$C_{10}H_{18}ClN$ α-Chlorodecanenitrile, 603
$C_{10}H_{18}O$ Borneol, 497
— Fenchyl alcohol, 496
— Terpineol, 496
$C_{10}H_{18}O_4$ Ethyl adipate, 452
— Ethyl dimethylsuccinate, 452
— Methyl ethylpropylmalonate, 452
— Methyl suberate, 452
— Propyl succinate, 451
— Sebacic acid, 404
$C_{10}H_{19}ClO$ Caprinoyl chloride, 511
— Decanoyl chloride, 511
$C_{10}H_{19}ClO_2$ β-Octyl chloroacetate, 513
$C_{10}H_{19}BrO_2$ Ethyl bromodipropylacetate, 514
— β-Octyl bromoacetate, 513
$C_{10}H_{19}IO_2$ β-Octyl iodoacetate, 513
$C_{10}H_{19}N$ Decanenitrile, 539
— 2-Methylnonanenitrile, 542
— 2-Methylpelargonitrile, 542
$C_{10}H_{19}NO$ Decene(2)amide, 585, 587
$C_{10}H_{20}O$ Butylamylketone, 364
— Menthol, 495
— Methyloctylketone, 362
$C_{10}H_{20}O_2$ *sec.*Amyl valerate, 435
— Butyl caproate, 436
— *sec.*Butyl caproate, 437
— Capric acid, 397
— Ethyl caprylate, 440
— Heptyl propionate, 426
— *sec.*Heptyl propionate, 426
— Hexyl butyrate, 430
— *sec.*Hexyl butyrate, 430
— Methyl pelargonate, 442
— *sec.γ*-Nonyl formate, 412
— Octyl acetate, 420
— *sec.*Octyl acetate, 420
$C_{10}H_{20}O_2$ Propyl oenanthate, 439
$C_{10}H_{21}NO$ Decaneamide, 584, 587
$C_{10}H_{22}$ Bi*iso*amyl, 105
— Decane, 103
— 2,7-Dimethyloctane, 105
— 2,4-Dimethyl-3-*iso*propylpentane, 107
— 2-Methylnonane, 106
— 3-Methylnonane, 106
— 4-Methylnonane, 106
— 5-Methylnonane, 106
— 2,2,3,3,4-Pentamethylpentane, 107
— 2,2,3,4,4-Pentamethylpentane, 107
— 2,2,3,3-Tetramethylhexane, 107
— 2,2,4,5-Tetramethylhexane, 107
— 2,2,5,5-Tetramethylhexane, 107
$C_{10}H_{22}O$ Decyl alcohols, 332
— *tert.* Decyl alcohol, 332
— Diamyl ether, 348
— Ethyl-*sec.*octyl ether, 350
$C_{10}H_{22}O_2$ 1,1-Dibutoxyethane, 352
— Dibutyl acetal, 352
$C_{10}H_{22}O_3S$ Diamyl sulphite, 621
$C_{10}H_{22}O_4S$ Diamyl sulphate, 621
$C_{10}H_{23}N$ Decylamine, 524

C_{11}

$C_{11}H_{10}$ 1-Methylnaphthalene, 180
— 2-Methylnaphthalene, 180
$C_{11}H_{11}NO_6$ Methyl *o*-nitrobenzoyloxypropionate, 601
$C_{11}H_{12}N_2O$ Antipyrine, 589
— Phenazone, 589
$C_{11}H_{12}N_2O_4$ Hippurylglycine, 587
$C_{11}H_{12}O$ Styrylethylketone, 479
$C_{11}H_{12}O_2$ Ethyl cinnamate, 485
— 5-Phenylpenten(3)oic acid, 481
$C_{11}H_{13}ClO_2$ Propyl phenylchloroacetate, 516
$C_{11}H_{14}$ 5-Methyl-1,2,3,4-tetrahydronaphthalene, 208
— 6-Methyl-1,2,3,4-tetrahydronaphthalene, 208
$C_{11}H_{14}O$ Butyl phenylketone, 478
$C_{11}H_{14}O_2$ *iso*Butyl benzoate, 485
— *sec.*Butyl benzoate, 485
— *m*-Butylbenzoic acid, 481
— *o*-Butylbenzoic acid, 481
— *p*-Butylbenzoic acid, 481
— Methylbenzylcarbinyl acetate, 482
— Methyleugenol, 473
— Methyl*iso*eugenol, 473
— *iso*Propenylresorcinol dimethylether, 473
$C_{11}H_{14}O_3$ Propyl mandelate, 486
— Propyl phenylglycolate, 486

$C_{11}H_{16}$ Amylbenzene, 161
— *m-tert.*Butyltoluene, 173
— *o-tert.*Butyltoluene, 173
— *p-tert.*Butyltoluene, 173
— Pentamethylbenzene, 172
$C_{11}H_{16}O$ 3-Methyl-4-*iso*propyl-1-methoxybenzene, 471
— *p*-Thymol methyl ether, 471
$C_{11}H_{16}O_2$ Hydroxythymol methyl ether, 471
— Hydroxy-*p*-thymol methyl ether, 471
— *iso*Propylresorcinol dimethylether, 473
$C_{11}H_{20}$ Undecyne-1, 140
$C_{11}H_{20}ClN$ α-Chloroundecanenitrile, 603
$C_{11}H_{20}O_2$ Undecen(10)oic acid, 404
$C_{11}H_{20}O_4$ Ethyl pimelate, 452
— Methyl azelate, 452
— Methyl dipropylmalonate, 452
— Nonane dicarboxylic acid, 404
— Propyl glutarate, 452
$C_{11}H_{21}N$ 2-Methyldecanenitrile, 542
— Undecanenitrile, 540
$C_{11}H_{21}NO$ Undecene(2)amide, 585, 587
$C_{11}H_{22}O$ Diamylketone, 360
— Methylnonylketone, 362
$C_{11}H_{22}O_2$ Amyl caproate, 436
— Butyl oenanthate, 439
— *sec.*Butyl oenanthate, 440
— Ethyl pelargonate, 443
— Heptyl butyrate, 430
— *sec.*Heptyl butyrate, 430
— Hexyl valerate, 434
— *sec.*Hexyl valerate, 435
— Nonyl acetate, 420
— *sec.*Nonyl acetate, 420
— Octyl propionate, 426
— *sec.*Octyl propionate, 426
— Propyl caprylate, 441
— Undecanoic acid, 398
$C_{11}H_{22}O_3$ *sec.*Octyl methoxyacetate, 453
$C_{11}H_{23}NO$ Undecaneamide, 584, 587
$C_{11}H_{24}$ Undecane, 107
$C_{11}H_{24}O$ Propyl-*sec.*octyl ether, 350
— *tert.*Undecyl alcohol, 332
$C_{11}H_{25}N$ Undecylamine, 524

C_{12}

$C_{12}H_9N$ Carbazole, 574
$C_{12}H_{10}$ Biphenyl, 174
$C_{12}H_{10}O$ Diphenyl ether, 473
$C_{12}H_{10}Se$ Diphenylselenide, 625
$C_{12}H_{11}N$ Diphenylamine, 563
$C_{12}H_{12}$ 1-Ethylnaphthalene, 180
— 2-Ethylnaphthalene, 180
$C_{12}H_{12}O$ Methylnaphthylcarbinol, 458
$C_{12}H_{12}O_2$ Methyl *allo*cinnamyl acrylate, 485
— Methyl 4-phenylbutadiene-1,3-carboxylate-1, 485
$C_{12}H_{14}O_2$ 1,2,3,4-Tetrahydro-2-naphthylacetate, 498
$C_{12}H_{15}ClO_2$ Butyl phenylchloroacetate, 516
$C_{12}H_{15}O_4$ Diethyl phthalate, 486
$C_{12}H_{16}O$ Amyl phenylketone, 478
$C_{12}H_{16}O_2$ Ethyleugenol, 473
— Methylbenzylcarbinyl propionate, 482
$C_{12}H_{18}$ *m*-Di*iso*propylbenzene, 173
— *o*-Di*iso*propylbenzene, 173
— *p*-Di*iso*propylbenzene, 173
— Hexamethylbenzene, 173
— Hexylbenzene, 161
$C_{12}H_{18}N_4O_7$ Triethylammonium picrate, 597
$C_{12}H_{18}O$ 3-Methyl-4-*iso*propyl-1-ethoxybenzene, 471
— *p*-Thymol ethyl ether, 471
$C_{12}H_{18}O_2$ Methoxymethylenecamphor, 498
$C_{12}H_{22}O_3$ Caproic anhydride, 376
$C_{12}H_{22}O_4$ Amyl oxalate, 452
— Decane dicarboxylic acid, 404
— Ethyl suberate, 452
$C_{12}H_{22}O_{11}$ β-Lactose, 505
— Saccharose, 504
$C_{12}H_{23}N$ Dicyclohexylamine, 568
— Dodecanenitrile, 540
— Lauronitrile, 540
— 2-Methylundecanenitrile, 542
$C_{12}H_{24}O$ Methyldecylketone, 362
$C_{12}H_{24}O_2$ Amyl oenanthate, 439
— Butyl caprylate, 441
— *sec.*Butyl caprylate, 442
— Decyl acetate, 420
— *sec.*Decyl acetate, 420
— Ethyl caprate, 443
— Ethyl decoate, 443
— Heptyl valerate, 434
— *sec.*Heptyl valerate, 435
— Hexyl caproate, 436
— *sec.*Hexyl caproate, 437
— Lauric acid, 398
— Octyl butyrate, 430
— *sec.*Octyl butyrate, 430
— Propyl pelargonate, 442
$C_{12}H_{24}O_{12}$ α-Lactose monohydrate, 505
— β-Maltose monohydrate, 505
$C_{12}H_{25}NO$ Dodecaneamide, 584
$C_{12}H_{26}$ Dodecane, 109
$C_{12}H_{26}O$ Butyl-*sec.*octyl ether, 350
— *tert.*Dodecyl alcohol, 332
$C_{12}H_{27}N$ Dodecylamine, 524
— Tributylamine, 524

$C_{12}H_{27}O_4P$ Tributyl orthophosphate, 625

C_{13}

$C_{13}H_{10}NAs$ Diphenylcyanoarsine, 625
$C_{13}H_{10}O$ Benzophenone, 478
$C_{13}H_{10}O_3$ Phenyl salicylate, 487
— Salol, 488
$C_{13}H_{12}$ Diphenylmethane, 174
$C_{13}H_{14}$ 1-*iso*Propylnaphthalene, 180
— 2-*iso*Propylnaphthalene, 180
$C_{13}H_{14}O$ Ethylnaphthylcarbinol, 458
$C_{13}H_{14}O_7$ Dimethyl monobenzoyltartrate, 488
$C_{13}H_{16}O$ Benzylidenepinacoline, 479
$C_{13}H_{16}O_2$ 1,2,3,4-Tetrahydro-2-naphthylpropionate, 498
$C_{13}H_{18}O$ Hexylphenylketone, 478
$C_{13}H_{18}O_2$ *sec.*Hexyl benzoate, 485
— Methylbenzylcarbinyl butyrate, 482
$C_{13}H_{20}O$ 3-Methyl-4,6-di*iso*propylphenol, 467
— *p-iso*Propylhymol, 467
$C_{13}H_{24}O_4$ Amyl malonate, 452
— Butyl glutarate, 452
— Ethyl azelate, 452
— Propyl pimelate, 452
— Undecane dicarboxylic acid, 404
$C_{13}H_{25}N$ 2-Methyldodecanenitrile, 542
— 2-Methyllauronitrile, 542
— Tridecanenitrile, 540
$C_{13}H_{26}O$ Dihexylketone, 360
— Methylundecylketone, 362
$C_{13}H_{26}O_2$ Amyl caprylate, 441
— Butyl nonoate, 442
— Butyl pelargonate, 442
— *sec.*Butyl nonoate, 443
— *sec.*Butyl pelargonate, 443
— Ethyl undecoate, 443
— Heptyl caproate, 437
— *sec.*Heptyl caproate, 437
— Hexyl oenanthate, 440
— *sec.*Hexyl oenanthate, 440
— Octyl valerate, 434
— *sec.*Octyl valerate, 435
— Tridecanoic acid, 399
— Undecyl acetate, 420
— *sec.*Undecyl acetate, 420
$C_{13}H_{28}$ Tridecane, 110
$C_{13}H_{28}O$ Amyl-*sec.*octyl ether, 350
— *tert.*Tridecyl alcohol, 332
$C_{13}H_{29}N$ Tridecylamine, 524

C_{14}

$C_{14}H_8O_4$ Quinizarin, 479
$C_{14}H_9Cl_5$ 1,1-Di-*p*-chlorophenyl-2,2,2-trichloroethane, 299
$C_{14}H_{10}$ Anthracene, 181
— 1,2-Diphenylacetylene, 177
— Phenanthrene, 182
$C_{14}H_{12}$ 1,2-Diphenylethylene, 176
— Stilbene, 176
$C_{14}H_{14}$ Bibenzyl, 176
— 1,1-Diphenylethane, 176
— 1,2-Diphenylethane, 176
$C_{14}H_{14}N_2O_3$ *p*-Azoxyanisole, 590
$C_{14}H_{14}O$ Phenylbenzylcarbinol, 458
$C_{14}H_{14}O_2$ Naphthylmethylcarbinyl acetate, 482
$C_{14}H_{15}N$ Dibenzylamine, 565
$C_{14}H_{20}O_2$ Methylbenzylcarbinyl valerate, 482
$C_{14}H_{22}$ Tetraethylbenzenes, 173
$C_{14}H_{22}N_4O_7$ Dimethyldipropylammonium picrate, 597
$C_{14}H_{27}N$ Myristonitrile, 541
— Tetradecanenitrile, 541
$C_{14}H_{28}O_2$ Amyl nonoate, 442
— Amyl pelargonate, 442
— *sec.*Amyl nonoate, 443
— *sec.*Amyl pelargonate, 443
— Dodecyl acetate, 420
— Ethyl laurate, 443
— Heptyl oenanthate, 440
— *sec.*Heptyl oenanthate, 440
— Hexyl caprylate, 442
— Myristic acid, 399
— Octyl caproate, 437
— *sec.*Octyl caproate, 437
— *sec.*Undecyl propionate, 426
$C_{14}H_{30}$ Tetradecane, 111
$C_{14}H_{30}O$ Hexyl-*sec.*-octyl ether, 350
— *tert.*Tetradecyl alcohol, 332
$C_{14}H_{31}N$ Tetradecylamine, 524

C_{15}

$C_{15}H_{16}O_2$ *sec.*Butyl naphthoate, 486
$C_{15}H_{18}O_7$ Diethyl monobenzoyltartrate, 488
$C_{15}H_{20}O_2$ 1,2,3,4-Tetrahydro-2-naphthylvalerate, 498
$C_{15}H_{21}ClO_2$ Octyl chlorobenzoate, 516
$C_{15}H_{21}BrO_2$ Octyl bromobenzoate, 516
$C_{15}H_{21}IO_2$ Octyl iodobenzoate, 516
$C_{15}H_{21}NO_4$ *sec.*Octyl *m*-nitrobenzoate, 601
— *sec.*Octyl *p*-nitrobenzoate, 601
$C_{15}H_{22}O$ Octylphenylketone, 478
$C_{15}H_{22}O_2$ Methylbenzylcarbinyl caproate, 482
— *sec.*Octyl benzoate, 485
$C_{15}H_{26}O_6$ Tributyrin, 444
$C_{15}H_{28}O_4$ Amyl glutarate, 452
— Butyl pimelate, 452
$C_{15}H_{29}N$ 2-Methylmyristonitrile, 542

$C_{15}H_{29}N$ 2-Methyltetradecanenitrile, 542
— Pentadecanenitrile, 541
$C_{15}H_{30}O_2$ *sec.*Butyl undecoate, 443
— Ethyl tridecoate, 443
— Heptyl caprylate, 442
— *sec.*Heptyl caprylate, 442
— *sec.*Hexyl nonoate, 443
— *sec.*Hexyl pelargonate, 443
— Methyl myristate, 443
— Nonyl caproate, 437
— *sec.*Nonyl caproate, 437
— Octyl oenanthate, 440
— *sec.*Octyl oenanthate, 440
— Pentadecanoic acid, 400
— Tridecyl acetate, 420
— *sec.*Tridecyl acetate, 420
— *sec.*Undecyl butyrate, 430
$C_{15}H_{32}$ Pentadecane, 112
$C_{15}H_{32}O$ Heptyl-*sec.*octyl ether, 350
$C_{15}H_{33}N$ Pentadecylamine, 524
— Tri*iso*amylamine, 524
— Triamylamine, 524
$C_{15}H_{33}O_4P$ Triamyl orthophosphate, 625

C_{16}

$C_{16}H_{10}$ Pyrene, 182
$C_{16}H_{12}O_2$ 1,2-Dibenzoylethylene, 479
$C_{16}H_{14}O_2$ 1,2-Dibenzoylethane, 479
$C_{16}H_{16}O_2$ Benzylmethylcarbinyl benzoate, 485
— Phenylbenzylcarbinyl acetate, 482
$C_{16}H_{24}O_2$ Methylbenzylcarbinyl oenanthate, 482
— *sec.*Nonyl benzoate, 485
— *sec.*Octyl *m*-toluate, 485
— *sec.*Octyl *o*-toluate, 485
— *sec.*Octyl *p*-toluate, 485
$C_{16}H_{24}O_3$ *sec.*Octyl *m*-methoxybenzoate, 486
— *sec.*Octyl *o*-methoxybenzoate, 486
— *sec.*Octyl *p*-methoxybenzoate, 486
$C_{16}H_{26}N_4O_7$ Diamylammonium picrate, 597
— Diethyldipropylammonium picrate, 597
— Methyltripropylammonium picrate, 597
$C_{16}H_{30}$ Hexadecyne-1, 140
$C_{16}H_{31}N$ Hexadecanenitrile, 541
— Palmitonitrile, 541
$C_{16}H_{32}O_2$ *sec.*Amyl undecoate, 443
— *sec.*Butyl laurate, 443
— Ethyl myristate, 443
— *sec.*Heptyl nonoate, 443
— *sec.*Heptyl pelargonate, 443
— Octyl caprylate, 442
$C_{16}H_{32}O_2$ *sec.*Octyl caprylate, 442
— Palmitic acid, 400
— *sec.*Undecyl valerate, 435
$C_{16}H_{34}$ Hexadecane, 112
$C_{16}H_{34}O$ Cetyl alcohol, 332
— Hexadecyl alcohol, 332
— Octyl-*sec.*octyl ether, 350
$C_{16}H_{35}N$ Hexadecylamine, 524

C_{17}

$C_{17}H_{20}O_2$ *sec.*Hexyl naphthoate, 486
$C_{17}H_{22}O$ Hexylnaphthylcarbinol, 458
$C_{17}H_{26}O_2$ Methylbenzylcarbinyl caprylate, 482
$C_{17}H_{28}N_4O_7$ Ethyltripropylammonium picrate, 597
$C_{17}H_{33}N$ Heptadecanenitrile, 541
— Margaronitrile, 541
$C_{17}H_{34}O_2$ *sec.*Amyl laurate, 443
— *sec.*Hexyl undecoate, 443
— Margaric acid, 401
— Methyl palmitate, 444
— *sec.*Octyl nonoate, 443
— *sec.*Octyl pelargonate, 443
— Undecyl caproate, 437
$C_{17}H_{36}$ Heptadecane, 113
$C_{17}H_{36}O$ Nonyl-*sec.*octyl ether, 350
$C_{17}H_{37}N$ Heptadecylamine, 524

C_{18}

$C_{18}H_{15}N$ Triphenylamine, 564
$C_{18}H_{15}As$ Triphenylarsine, 625
$C_{18}H_{15}Bi$ Triphenylbismuthine, 625
$C_{18}H_{15}P$ Triphenylphosphine, 625
$C_{18}H_{15}Sb$ Triphenylstibine, 625
$C_{18}H_{18}N_2O_5$ Ethyl *p*-azoxybenzoate, 590
$C_{18}H_{18}O_2$ Propyl phenylcinnamate, 485
$C_{18}H_{22}O_2$ *sec.*Heptyl naphthoate, 486
$C_{18}H_{28}O$ Undecylphenylketone, 478
$C_{18}H_{28}O_2$ Methylbenzylcarbinyl pelargonate, 482
— *sec.*Undecyl benzoate, 485
$C_{18}H_{30}$ Dodecylbenzene, 160
$C_{18}H_{30}N_4O_7$ Tetrapropylammonium picrate, 597
$C_{18}H_{34}$ Octadecyne-1, 140
$C_{18}H_{34}O_2$ Elaidic acid, 404
— Octadecen(17)oic acid, 404
— Oleic acid, 404
— Stearenic acid, 404
$C_{18}H_{34}O_3$ Ricinoleic acid, 405
$C_{18}H_{34}O_4$ *sec.*Octyl oxalate, 448
$C_{18}H_{35}N$ Octadecanenitrile, 541
— Stearonitrile, 541

$C_{18}H_{36}O$ Ethylpentadecylketone, 364
$C_{18}H_{36}O_2$ *sec.*Butyl myristate, 443
— Cetyl acetate, 421
— Dodecyl caproate, 437
— Ethyl palmitate, 444
— *sec.*Heptyl undecoate, 443
— *sec.* Hexyl laurate, 443
— *sec.*Nonyl nonoate, 443
— *sec.* Nonyl pelargonate, 443
— Stearic acid, 402
— *sec.*Undecyl oenanthate, 440
$C_{18}H_{38}$ Octadecane, 113
$C_{18}H_{39}N$ Octadecylamine, 524

C_{19}

$C_{19}H_{16}$ Triphenylmethane, 175
$C_{19}H_{16}O$ Triphenylcarbinol, 458
$C_{19}H_{24}O_2$ Naphthylhexylcarbinyl acetate, 482
— *sec.*Octyl naphthoate, 486
$C_{19}H_{30}O_2$ Methylbenzylcarbinyl decoate, 482
$C_{19}H_{36}O_2$ Methyl elaidate, 456
— Methyl oleate, 456
$C_{19}H_{38}O_2$ *sec.*Decyl nonoate, 443
— *sec.*Decyl pelargonate, 443
— *sec.*Heptyl laurate, 443
— *sec.*Octyl undecoate, 443
— Propyl palmitate, 444
— Tridecyl caproate, 437
$C_{19}H_{38}O_4$ Monopalmitin, 446

C_{20}

$C_{20}H_{16}$ Triphenylethylene, 177
$C_{20}H_{16}Cl_2O_8$ Methyl bis (chlorobenzoyl) tartrate, 516
$C_{20}H_{16}Br_2O_8$ Methyl bis(bromobenzoyl) tartrate, 516
$C_{20}H_{16}I_2O_8$ Methyl bis(iodobenzoyl)tartrate, 516
$C_{20}H_{18}$ 1,1,1-Triphenylethane, 176
— 1,1,2-Triphenylethane, 176
$C_{20}H_{18}O_2$ Benzylmethylcarbinyl naphthoate, 486
$C_{20}H_{18}O_8$ Dimethyl dibenzoyltartrate, 488
$C_{20}H_{26}O_2$ Naphthylhexylcarbinyl propionate, 482
— *sec.*Nonyl naphthoate, 486
$C_{20}H_{32}O$ Tridecylphenylketone, 478
$C_{20}H_{32}O_2$ Methylbenzylcarbinyl undecoate, 482
$C_{20}H_{34}$ Tetradecylbenzene, 160
$C_{20}H_{38}O_2$ Ethyl elaidate, 456
— Ethyl oleate, 456
$C_{20}H_{40}O_2$ Arachidic acid, 402
— *sec.*Butyl palmitate, 444
$C_{20}H_{40}O_2$ Ethyl stearate, 444
— *sec.*Hexyl myristate, 443
— *sec.*Nonyl undecoate, 443
— *sec.*Octyl laurate, 443
— Tetradecyl caproate, 437
— *sec.*Undecyl nonoate, 443
— *sec.*Undecyl pelargonate, 443
$C_{20}H_{42}$ Eicosane, 114

C_{21}

$C_{21}H_{21}N$ Tribenzylamine, 565
$C_{21}H_{28}O_2$ *sec.*Decyl naphthoate, 486
— Naphthylhexylcarbinyl butyrate, 482
$C_{21}H_{34}O_2$ Methylbenzylcarbinyl laurate, 482
$C_{21}H_{36}N_4O_7$ Triamylammonium picrate, 597
$C_{21}H_{38}O_6$ Tricaproin, 444.
$C_{21}H_{40}O_2$ Propyl elaidate, 456
— Propyl oleate, 456
$C_{21}H_{42}O_2$ *sec.*Decyl undecoate, 443
— *sec.*Dodecyl nonoate, 443
— *sec.*Dodecyl pelargonate, 443
— *sec.*Heptyl myristate, 443
— *sec.*Nonyl laurate, 443
— Pentadecyl caproate, 437
— Propyl stearate, 444
$C_{21}H_{44}$ Heneicosane, 113

C_{22}

$C_{22}H_{22}O_8$ Diethyl dibenzoyltartrate, 488
$C_{22}H_{30}O_2$ Naphthylhexylcarbinyl valerate, 482
— *sec.*Undecyl naphtoate, 486
$C_{22}H_{34}O_2$ 1,2,3,4-Tetrahydro-2-naphthyllaurate, 498
$C_{22}H_{36}O_2$ Methylbenzylcarbinyl tridecoate, 482
$C_{22}H_{38}O$ Phenylcetyl ether, 471
$C_{22}H_{42}O_2$ Butyl elaidate, 456
— Butyl oleate, 456
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$C_{22}H_{44}O_2$ *sec.*Butyl stearate, 444
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— *sec.*Octyl myristate, 443
— *sec.*Tridecyl nonoate, 443
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$C_{22}H_{46}$ Docosane, 114

C_{23}

$C_{23}H_{32}O_2$ Naphthylhexylcarbinyl caproate, 482
$C_{23}H_{38}O_2$ Methylbenzylcarbinyl myristate, 482

$C_{23}H_{46}O$ Dilaurylketone, 360
$C_{23}H_{46}O_2$ *sec.*Dodecyl undecoate, 443
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$C_{23}H_{48}$ Tricosane, 113, 114

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$C_{24}H_{34}O_2$ Naphthylhexylcarbinyl oenanthate, 482
$C_{24}H_{40}O_2$ Methylbenzylcarbinyl pentadecoate, 482
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$C_{25}H_{20}$ Tetraphenylmethane, 175
$C_{25}H_{36}O_2$ Naphthylhexylcarbinyl caprylate, 482
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$C_{26}H_{54}$ 13-Methylpentacosane, 113

C_{27}

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$C_{27}H_{46}O_2$ Methylbenzylcarbinyl stearate, 482
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$C_{32}H_{26}$ Pentaphenylethane, 176
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$C_{35}H_{72}$ Pentatriacontane, 113

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$C_{39}H_{74}O_6$ Trilaurin, 445

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